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SCUBAPRO®

Diving & Snorkeling

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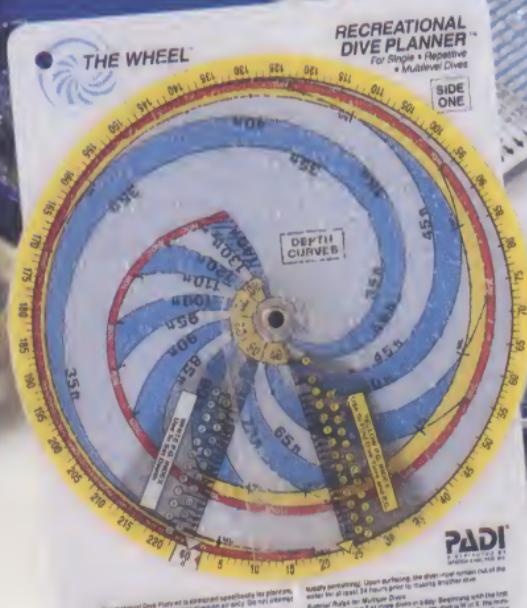
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Simplify Your Dive Tables.

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The Recreational Dive Planner is designated specifically for planned, controlled, and/or decompression diving dives only. Do not attempt to use it for planning non-decompression dives.

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D. Holden Bailey



Editor's Page

Did you know the research used to create the Dive Table we all use today was done in 1910? This is one of several surprises you'll find in Eric Hanauer's article on the Tables which appears on page 18 of this issue of SCUBAPRO Diving & Snorkeling.

The Dive Tables are based on dissolved gas theory developed by John Scott Haldane, a British physiologist, 80 years ago. That's not to say the Tables are no longer valid nor that they have not been modified over the years, but diving today is nothing like it was 80 years ago or even 30 for that matter.

Today's sport diver makes multi-day, multi-level, and multi-dives. This type of diving just isn't addressed by dissolved gas theory. So along come the bubble mechanics theorists. These physicists are looking at the whole spectrum of sport diving with an eye to create a new set of Tables encompassing both free and dissolved gas theory. The work, when complete, will give all divers a set of Tables they can use with confidence and safety. We'll be keeping a close eye on developments and will report them to you as soon as possible.

For the traveling diver, we've covered the four corners of the country in this issue and added a Caribbean destination for good measure. Darren Douglass takes a look at the history of the Channel Islands in Southern California and the diving. His look at this unique marine environment begins on page 8.

Washington, in the extreme northwest corner of the country, is fast becoming a dive destination in its own right. F. Stuart Westmorland heralds the glories of cold-water diving and details many of the best sites beginning on page 40.

Many East Coast divers go to spots in New Jersey and New York. Herb Segars dispels myths about diving in that area beginning on page 38. Among other things, there's a year-round season on lobster with no limits and no licenses required in New Jersey.

Anchoring the package is Walt Stearns' article on diving the marine parks of the Florida Keys on page 12. These sanctuaries offer divers vast tracts of the seafloor to explore and enjoy. Walt points out the need for greater protection of the delicate marine environment of these southernmost islands.

Caribbean divers should take note of Tim O'Keefe's update article on Aruba on page 22. This island neighbor of Bonaire and Curacao is doing new things to attract divers, including sinking a few of their excess confiscated airplanes along the coast.

In the next issue of SCUBAPRO Diving & Snorkeling we will publish the exclusive account of Gary Gentile's dives on the Monitor. Gary plans to use his hard fought for permit in July and if the weather and sea cooperate, we'll have his photos and account in the Winter 1991 issue which will be on the newsstand or in your mailbox in October.

We want to learn more about your likes and dislikes regarding your diving, and the kind of information you'd like to see more of in future issues. So make sure you answer the readership survey on page 36—which will automatically give you a shot at some prizes! In the meantime, enjoy a summer of good and safe diving.

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Ocean Sports International's

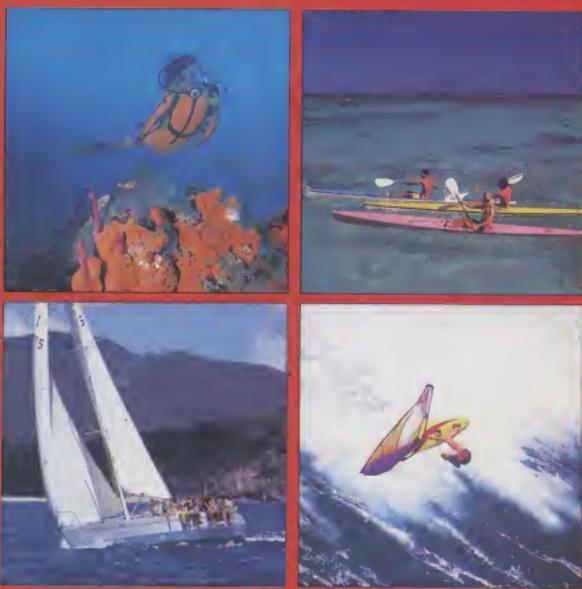
Buyer's Guide to Ultimate Dive Destinations

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Look for special sections with information on accommodations, diving facilities, types of boats and equipment, diving skill levels, dive sites, resort courses, after-dive activities, other water sports activities, sightseeing, nightlife, and prices. We'll also give you the low down on what you'll need—visas, bug spray, shots, casual clothing, formal dinnerwear, and sweaters—so you'll be ready for anything in or out of the water.

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The pair of leaky, worm-infested caravels bucked and yawed their way into the strong northwesterly wind and swell. Inside the creaking hold, what scant provisions remained were starting to sour as dampness seeped into wood barrels containing rations of salted beef and hard bread. The supply of water taken aboard at San Diego had turned foul. As the small contingent of ships was buffeted by Point Conception headwinds, Capitan Juan Rodriguez Cabrillo encouraged his men, helping to maintain their sagging spirits.

The crew represented a motley band of expatriated seamen, conscripts, bored frontier soldiers awaiting years of back pay, and a few Indians. It was unusual that a Portuguese, not a Spaniard, led this voyage for the Viceroy of New Spain, but Cabrillo was a veteran of the campaign of Mexico led by conquistador Hernan Cortes, and had proven himself as a gifted navigator and capable explorer.

Progressing slowly northward through the increasingly heavy seas, Cabrillo ordered the ship secured for gale conditions. The winds increased, beating the ship slowly southeast. Surely such hardship would be rewarded with discoveries of value to the crown. Confident the Strait of Anian lay ahead, Cabrillo pressed on in search of the legendary waterway from New Spain to the riches of the Orient.

"Land Ho!" a lookout shouted. Through the biting spray and rising waves, Cabrillo could make out the shadow of an island in the distance. As they neared the land, Cabrillo could see the rocky shoreline would never permit a safe landing. Quickly he shouted orders to fall away to the island's leeward side. He ordered the ships to sail a safe distance from shore as he

Darren Douglass is the author of over 30 articles and photo essays. His work has appeared regularly in diving magazines. Darren is also the associate editor of *Discover Diving*.

In the Wake of CABRILLO

Under the management of the National Park Service, the rich history and underwater beauty of California's Channel Islands are a magnet for West Coast divers.

surveyed the coast through the mist. The date was October 18, 1542.

Cabrillo named the island La Pose-
sion. Many years later, the island would
be renamed San Miguel by the English
explorer, George Vancouver.

History credits Captain Cabrillo and his men with the discovery of San Miguel and Santa Rosa islands off the Santa Barbara coast; as well as Santa Catalina farther south. Unfortunately for Cabrillo, a short sea route to the East Indies did not exist.

When explorers failed to find gold or native riches in the new northern territory, Spain soon lost interest in the inhospitable islands off the barren shores of Alta California. Indians were numerous and not always friendly and the jagged offshore reefs and pinnacles posed threats to shipping. Cabrillo's voyage was of historical significance as it charted the beginning of a new sea route to the vast and unexplored western coast of North America.

Four islands lie off the Santa Barbara Channel: Anacapa (farthest to the south), Santa Cruz, Santa Rosa and San Miguel. From wind-blown San Miguel with its roaming sand dunes to long, thin Anacapa with its vertical cliffs, each island is unique. All are rich in oceanographic beauty.

Today the islands are managed by the National Park Service, and make up the Channel Islands National Monument. The NPS offers land-oriented visitors access by private boat and water taxi.

Hikers can observe the breathtaking fields of bright yellow coreopsis flowers, pastoral valleys and sheer cliffs plummeting into the swirling sea below. The best of the Channel Islands, however, lies beneath the surface, available only to divers. A short boat ride from the Los Angeles or Santa Barbara harbors brings today's underwater explorers to some of the finest temperate-water diving in the world. The geology beneath the ocean surface is as diverse as the islands are above. Divers will find reefs, sheer walls, jutting pinnacles, and an abundance of marine life. Island waters are home to playful sea lions, huge basking sharks, delicate nudibranchs, and gardens of corals and anemones. Hunters will encounter lobster, scallops and many species of game fish. Photographers will relish the clarity of sunlit kelp beds and bluewater dropoffs. The Channel Islands should be on every diver's underwater itinerary.

Anacapa Island

Farthest south in the Channel Islands group, Anacapa is actually a group of three small islets. The Chumash Indians named the island *Wima*, meaning "ever changing" or "deception." Depending on a mariner's approach, Anacapa can appear to be one, two or three islands.

Here, divers can descend through thick amber kelp forests where scores of fish meander through the stalks. To preserve the pristine beauty of the island, the Park Service maintains



*Spotted rose
anemone,
Santa Rosa
Island.*

reserve areas such as Cathedral Cove where no game may be taken. Here divers can experience an unspoiled sampling of the island's marine environment. Sea lions dart among the reefs and large fish thrive. During the fall and winter months, visibility can exceed 100 feet due to the cleansing action of the current. Average visibility is in the 30-60-foot range.

Anacapa was the site of the first major shipwrecks recorded at the Channel Islands. Occurring in 1853, the Pacific Mail steamship *Winfield Scott* struck a submerged pinnacle and ran aground near Middle Island. Today, divers can explore the scattered remains of this 136-year-old paddlewheel steamship in less than 30 feet of water. Strewn throughout the shallows lie sheets of copper and splintered deck planks.

Santa Cruz

Northern neighbor to Anacapa, Santa Cruz is the largest of the Santa Barbara Channel Islands. Its topography and climate are ideal for ranching. Since the 1800s flocks of sheep and cattle have grazed the island's green hillsides and broad fields of grass.

Underwater, Santa Cruz is well known for its extensive kelp beds, rolling reef systems, clear water and an extensive variety of marine life. Some of the most extensive underwater cave systems throughout the Channel Islands can also be found here. Painted Cave, on the windward side of the

island features a intertidal cavern large enough to accommodate the 78-foot dive boat *Vision*. The island also features several interesting shipwrecks. Near Scorpion's Anchorage can be found the wreck of a U.S. Navy minesweeper. Here, divers may examine the deteriorating remains of this large wooden vessel now home to burrowing worms, anemones and scores of iridescent nudibranchs. On the other side of the island, outside Laguna Harbor, a Grumman Intruder rests in 60 feet of water. The aircraft sits upright in the sand, wings outstretched as if ready to land. Attached kelp fronds slowly wind their way to the surface.

Divers will almost always encounter throngs of California sea lions at Gull Island on the ocean side of Santa Cruz. On the sand flats near Profile Point nomadic angel sharks, halibut and Pacific electric rays can often be seen. The inshore shallows feature bat rays and countless bright anemones.

Santa Cruz is even more popular when the sea is rough as its leeward side offers many sheltered anchorages. These same protected coves are used by divers when adverse conditions make other areas undivable.

Santa Rosa

Farther north lies the island of Santa Rosa, the second largest in the group and an excellent producer of lobster and scallops. Talcott Shoals is a favorite of game seeking divers. Photographers also find Santa Rosa has much to offer. Colorful invertebrates and fish life abound just about anywhere a dive boat drops anchor. Average visibility ranges between 40 and 80 feet as a result of strong currents which pass close to the island.

Large fish are frequently seen. At Carrington Point divers often find a resident black sea bass, a giant of the grouper family, weighing close to 500 pounds. The black sea bass are protected in California and may not be speared. The bass are curious beasts and often swim very close to divers. Keep your camera ready!

Santa Rosa has several shipwrecks as well. The 265-foot grainer *Agi* ran aground on Talcott Shoals in 1915. It's anemone-covered remains are now scattered in 20 to 60 feet of water. The 268-foot collier *Goldenhorn* crashed onto the island's shallow windward shores in 1892. Both wrecks are easy dives. Their masts, decks and hull plates lie strewn over a wide area.

Numerous pinnacles, reefs and ledges near the island are home to brilliant yellow, blue, purple and red nudibranchs and concentrations of colorful anemones. Pacific electric rays boldly cruise the sand corridors; the undersea bedou-

ins of the plains beyond the reefs. Seven-gill sharks cruise deeper-water ledges and varieties of red and vermillion rockfish cover the rocky bottom.

San Miguel

Most northerly of the Channel Islands, San Miguel is located some 20 miles from Point Conception on the mainland. Here the weather can change dramatically with little warning. Gale force winds often roar out of the north and slam full force into San Miguel's

(Please turn to page 76)

TRUTH AQUATICS

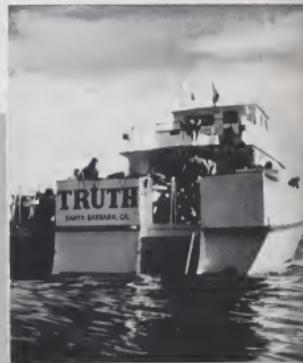
*O*ne of the most popular and well-established operators carrying divers to the Channel Islands is Truth Aquatics. Divers can sail on the 65-foot Truth, the 75-foot Conception, and the newest addition to the fleet, the luxurious 80-foot Vision. The boats are stable, fast, comfortable and well equipped with many amenities. But it takes more than good boats to make a charter operation a class act. It takes motivated people running it.

"Our philosophy has always been, and will always be, that we want to be recognized by our peers within the professional diving industry as professionals ourselves," states Roy Hauser, the founder of Truth Aquatics.

The Truth Aquatics philosophy has always been one of a commitment to excellence. Their attitude is simple, "Treat passengers like friends and they will keep coming back." This has been the unwritten credo of the operation since its founding in 1966.

As the business grew, Roy was joined by his partner, Glen Fritzler. Together they moved the operation to Santa Barbara.

All Truth Aquatics vessels have been custom built, constructed from the keel up for divers. Each vessel features several hot, freshwater showers, a galley, and large salon. The upper sundeck is available for lounging or a between-dive nap. Below decks, divers will find



spacious, well ventilated bunkrooms with individual reading lamps. The boats also feature a fish freezer and water-circulating live wells built into the swim step. These tanks are excellent for keeping lobster and abalone alive during multi-day dive trips. There is also a dryer for towels and bathing suits, and most importantly, a wet suit drying room near the engine compartment. Ample table space in the galley allows plenty of room for photographers to work with their cameras.

Truth Aquatics runs 2-, 3- and 5-day excursions to the Channel Islands. Single-day trips are available during the week. On multi-day trips, all food and air is included in the price of the passage, as well as a multi-day game taking permit. A California fishing license is also required.

The Truth Aquatics fleet is docked at Sea Landing in Santa Barbara. Phone: (805) 962-1127. This harbor is within a 2- to 3-hour run of Anacapa, Santa Cruz and San Miguel islands. Occasionally, trips are made to the mainland coast near Point Conception. Truth Aquatics dives the islands just about every day of the year. The captains and crews are all avid divers themselves and know the islands well.

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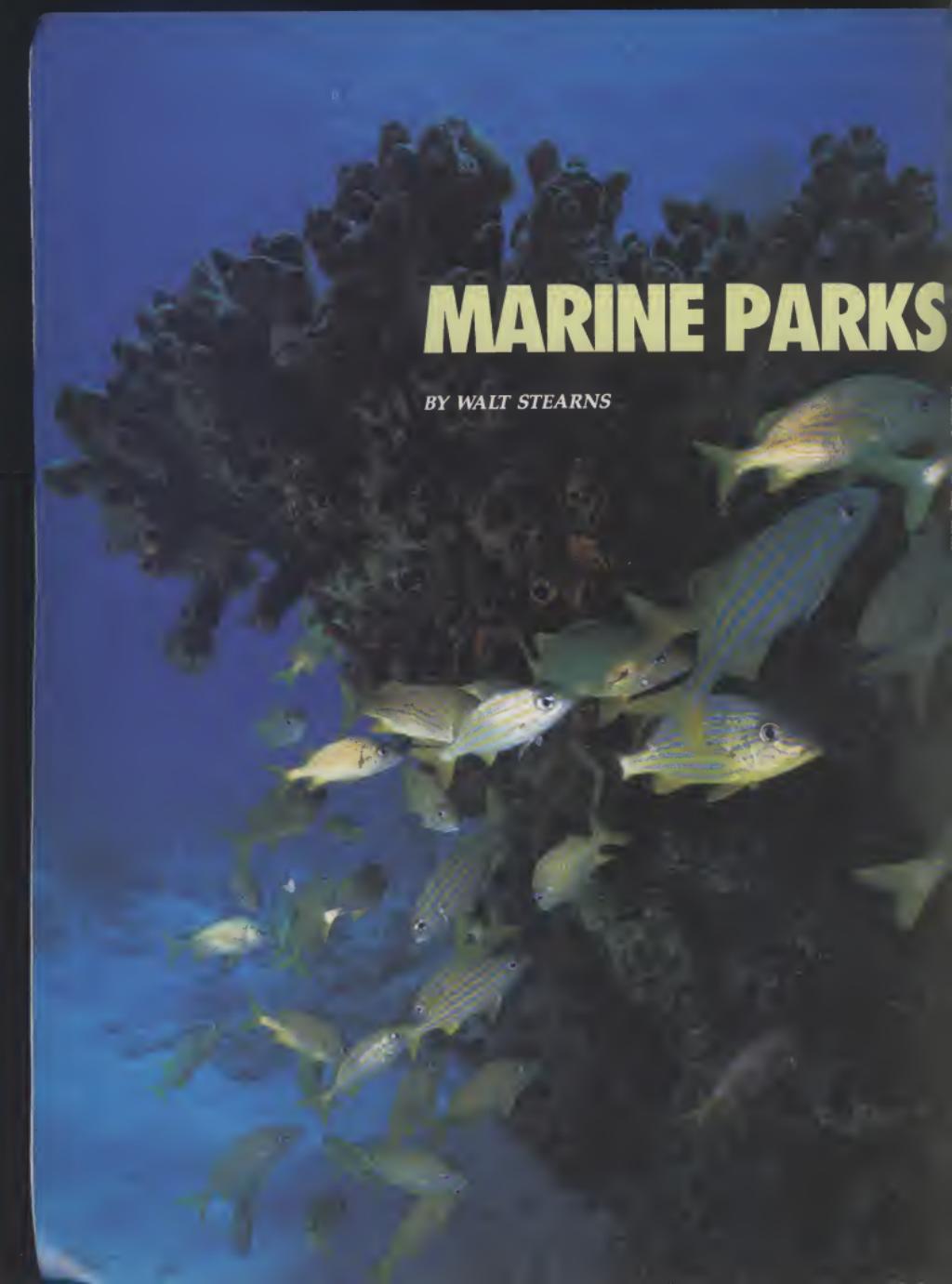
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MARINE PARKS

BY WALT STEARNS

Southeast of the Florida Peninsula lies a chain of islands that eventually disappears into the Gulf of Mexico. Warmed by the Gulf Stream, the Florida Keys have earned a reputation as America's own tropical out islands. This island chain provides a touch of Caribbean soul with its warm, clear waters, balmy sea breezes and fascinating reefs.

Over a million people visit the Florida

of the Florida Keys

Keys each year and over half of these guests are scuba divers. The remainder are fishermen looking to try their hand at the Keys' fabulous game fish, or simply northern snowbirds out to grab a little sunshine. This large number of vacationers is not at all surprising when you consider that the Florida Keys are part of the good ole U.S.A., easily accessible by automobile.

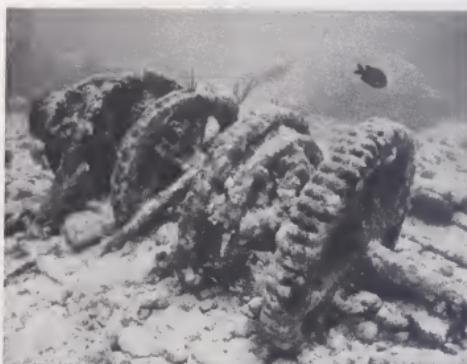
Extending along a 100-mile strip of roadway, the Keys are one of the most extensively developed places for visiting divers, a sort of continuous string of hotels, dive shops, restaurants and resorts offering a variety of affordable rates for its clientele.

Perhaps the most substantial attraction offered by the Florida Keys is the warm water temperatures and its dense concentration of marine life. This rich biomass consisting of large number of fish and other varieties of marine life is quite an awesome sight for divers visiting from as far north as Canada.

Reef-building corals can only flourish in an environment with favorable conditions. Waters consistently warmer than 68 degrees Fahrenheit and free of suspended sedimentary particles are essential. This environment is typically found between the narrow constraints of 25 degrees North and 25 degrees South Latitude.

Running parallel to the Keys, the coral reef system stretches for more than 150 nautical miles. Formed through thousands of years of coralline growth, the Florida reef tract is the largest coral reef system of the North American continent. The reef system of the Florida Keys is one of the northernmost fringes of coral reef development in the Caribbean. For Florida, the biologically productive

Foresight and planning have resulted in huge tracts of the seafloor being preserved and protected for the enjoyment of divers.



A large school of grunts, opposite, find shelter under a ledge near the winch from one of the many wrecks at Molasses Reef.

nature of the coralline communities provides the very foundation of the rich and diverse population of plant and animal life that depends on the reef's own ecosystem for shelter and food. Other associated habitats such as surrounding seagrass beds, smaller patch reefs and sand flats also add to an already broad number of marine life forms that make the reef their home.

Unfortunately, there are presently no true reef formations within swimming distance of shore, making a boat a necessity for reaching the more spec-

tacular reefs that lie farther offshore. Although they may lack the steep, dramatic drop-offs and deep-winding coral crevasses encountered in other parts of the Caribbean, the reefs of the Florida Keys are nonetheless beautiful in their own right.

The State of Florida, with the National Parks System and the National Oceanic and Atmospheric Admini: tration (NOAA) has created several underwater parks and/or marine sanctuaries in the southern part of Florida during the past several years. Through the designation

Walt Stearns, a Florida-based free-lance writer and photographer, began snorkeling at age three. He was a diver for Miami Seaquarium and is currently a PADI assistant instructor.

of specific tracts of marine habitat as protected sanctuaries, the underlying ecosystem will be maintained for years of enjoyment to come.

Named after Biscayne Bay, the Biscayne National Park stretches across the upper portion of the Florida Keys and southern end of Biscayne Bay. It is the largest underwater park in the nation, covering some 176,000 square acres of bay and ocean floors, with only four percent of the park's area consisting of dry land.

Naturally partitioned from the ocean by a narrow strip of land that is part of the upper Florida Keys, the southern end of Biscayne Bay makes up more than 50 percent of the park. This region is comprised of a vast underwater plain of sea grasses, mud and sand, with the occasional soft coral and sponge dotting the bottom. Due to the nature of this habitat, the area is host to an amazing variety of marine life, and is a particularly important nursery for lobster, shrimp, crab and game fish. Because of its

significance as a breeding ground, this portion of the park has been declared a marine sanctuary, thereby making it illegal to take or harm any of its inhabitants. Outside the bay, the park is host to numerous reefs and wrecks running its entire length. The reef topography of this area is not unlike that found a little farther south in John Pennekamp State Park. Typically, depths range from as shallow as one foot to 100 feet or more. When the weather is good and the seas calm, visibility can range anywhere from 50 to 70 feet.

One of the more attractive features about Biscayne National Park for the sportsman, is the set of rules regulating spearfishing. While the taking of small tropical reef fish, corals and shells is prohibited (enforced with stiff fines and penalties), Biscayne National Park is presently the only marine park or sanctuary in South Florida that permits spearfishing in some areas.

Of all the marine parks and sanctuaries in the world, none have been

more widely recognized and acknowledged than the John Pennekamp Coral Reef State Park. What makes this marine park unique, other than the beauty of its coral gardens, could be the fact that it was the first marine park of its kind to be found in the United States. Only after strong lobbying efforts by Florida conservationists, led by Miami newspaperman John Pennekamp, did the State of Florida understand the need for establishing a marine park. On December 10, 1960, the State of Florida finally established the John Pennekamp Coral Reef State Park (named after the man who dedicated his life to its protection) and marked the first underwater park in the nation.

Until several years ago, the state park's boundaries encompassed some 75 square miles of ocean, extending three miles from Key Largo's shoreline. The federal government, fearing that state protection might not be sufficient to safeguard this complex and fragile ecosystem from further coral destruction

SAVING THE REEFS

Regrettably, most of the reefs in the Florida Keys suffer some damage from human activity. While boat anchors and divers quite often break off pieces of the reefs, the real threats to our coral-reef ecosystems are the discharge of pollutants from oil spills and offshore waste-dumping, and the disruption of sediments caused by dredging and/or underwater construction. Each activity harms the coral polyp, either by blocking out the rays of the sun, which the symbiotic algae inside the polyp need to survive, or through the direct attack of toxic chemicals on the delicate tissues of the polyp itself. Coral seldom grows back damaged, particularly while the harmful activity continues.

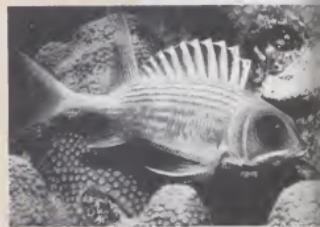
In addition to the more serious problem of pollution, grounding has become an increasing cause of concern. Between October 25 and November 10, 1989, three freighters ran aground on the coral reefs of the Florida Keys. Even more disheartening, all three incidents occurred within the boundaries of marine sanctuaries, two occurring inside Key Largo National Marine Sanctuary, the third in Fort Jefferson.

On November 17, 1989, South Florida Congressman Dante Fascell introduced a bill entitled the "Florida Keys National Marine Sanctuary Act of 1989." The bill, if fully enacted, will limit the operation of vessels near marine sanctuary boundaries. To do so, the bill requires the Secretary of Commerce to work with the U.S. Coast Guard and the Governor of Florida to develop regulations designating areas where restricted vessels would be allowed to operate.

There are at present a few organizations dedicated to protecting America's only coral reef system. One of the more notable groups is Project ReefKeeper.

An affiliate of the American Litoral Society, founded in 1961, Project ReefKeeper is a national, nonprofit organization committed to the study and conservation of aquatic life throughout North America's coastal zone—a sort of conservation watchdog for environmental misconduct.

For more information, contact: Project ReefKeeper, 16345 W. Dixie Highway, Suite 1121, Miami, FL 33160. \$



Longjaw squirrel fish

and over-fishing, established a marine sanctuary in 1975. The sanctuary includes a large portion of John Pennekamp Park, and an additional tract of ocean floor extending from two to three miles further out to sea (to depths of 300 feet, on the Continental Shelf).

Today the John Pennekamp Coral Reef State Park/Key Largo National Marine Sanctuary's jurisdiction encloses a 104-square-mile area, five to six miles wide and 20 miles long. With its northern perimeter beginning at the southern perimeter of Biscayne National Park, the sanctuary extends as far south as Molasses Reef, placing over 14 miles of major reef banks inside its boundaries. Presently, the marine sanctuary protects not only the coral reefs that run parallel to the keys, but the adjacent mangrove swamps and grass beds inside the park's boundaries.

Each year, close to a million divers, snorkelers and sportfishingermen visit this park, making it the largest hub for divers and sightseers in the Keys. Home to approximately 500 species of fish, the reef communities of this world-famous park are formed by over 35 species of West Indies coral. Nearly every outcropping, overhang, cave and crevice teems with life. While most of the stands of coral rise only 10 to 15 feet off the bottom, several of the major reefs like Carysfort, The Elbow, French and Molasses, have precipices reaching as high as 25 feet above the ocean floor.

Located 6.7 nautical miles southwest of Big Pine Key is the Looe Key National Marine Sanctuary. Graced with some of the most stunning "spur and groove" formations the Keys have to offer, Looe Key is considered by some to be one of the most biologically productive coral reef ecosystems in the lower half of the Florida Keys. Many of the reef's high-profile coral fingers (spurs) extend more than a hundred feet and stand as high as 25 feet off the bottom. Several offer deep sand valleys (grooves) and a multitude of large coral overhangs with ceilings high enough for a diver to swim under.

Since 1981, the site surrounding Looe Key has been designated a National Marine Sanctuary by the National Oceanic and Atmospheric Administration. However, active administration did not begin until 1983, with the installation of 70 mooring buoys around the reef zone, intended to help reduce anchor damage. Today Looe Key encompasses 5.3 square miles of federally protected water.

Not far from the reef is the remains of the *H.M.S. Looe*. Many facts concerning the demise of this British frigate are still unclear, including the actual date of her sinking (1742 or 1744). What is certain is that the *Looe* burned to the water

line. Today, all that remains is an old anchor, a couple piles of ballast stones and a few 50-pound iron ingots scattered about the ocean floor.

Approximately 65 miles due west of Key West lies a small group of coral islets commonly known as the Dry Tortugas. Fed by the constant flow of warm, clear water provided by the Gulf Stream, the Dry Tortugas are surely among Florida's most pristine locations. Unlike the rest of the Keys, the Dry Tortugas are relatively free of urban development; probably due to their inaccessibility from the mainland.

Below the surface, the marine topography has a much more dramatic range of depth than is found throughout the rest of the Keys. Here divers encounter mini-walls or ledges that sometimes drop straight down, 50 feet or more. The region's remoteness and its constant bathing from the Gulf Stream just about guarantee underwater visibility in the 80- to 100-foot plus range, year-round.

The Dry Tortugas offer the opportunity not only for numerous and rewarding dives, but for retracing a portion of America's early history. The remains of old Fort Jefferson stand on the islets' Garden Key. Construction began in 1846 by the U.S. military on the mammoth, six-sided, three-tier fortress intended to hold a garrison of 7,500 troops and an armament of 450 cannons.

Although building continued for 30 years, she was never completed nor did she ever see action, even during the Civil War. Following the War, the fort was converted into a prison, which housed one famous inmate, Dr. Samuel Mudd. He was the physician who is said to have set John Wilkes Booth's broken leg after the assassination of Lincoln.

It was not until January 4, 1935, that Fort Jefferson and its surrounding reefs and islands were proclaimed a national preserve by Franklin D. Roosevelt, and placed under the jurisdiction of the National Parks Service.

Today the park is a National Monument and Marine Preserve. Spearfishing is prohibited within the monument's boundaries, though fish may be taken at depths beyond 70 feet, where they fall outside the park's jurisdiction.

The rewards of visiting America's only tropical marine sanctuaries are worth the effort, regardless of which marine park you choose to visit—the easily attainable John Pennekamp or Looe Key, or the less accessible Fort Jefferson. A convenient mooring-buoy system installed by Florida park management and conservation groups, tropical climate and warm water make the Florida Keys easily one of the best diving locations in the United States. **S**



REEF ETIQUETTE

It has already been shown that human activity has a direct impact on both long- and short-term health of coral communities. While swimming, snorkeling and scuba diving are encouraged in all protected marine sanctuaries, it is important to follow proper reef etiquette when visiting them.

- 1. Do not handle or stand on any coral formations.*
- 2. Do not discharge refuse or any other pollutants inside the park sanctuary boundaries.*
- 3. Do not allow your anchor, anchor chain or line to make contact with coral. It is strongly recommended that you use the mooring buoys provided.*
- 4. Do not remove or disturb corals, fish or any other marine organisms, with the exception of spiny lobster and stone crabs (allowed under the appropriate Fishery Management Plan) inside the park sanctuary boundaries. Always check first with the appropriate officials for regulations and restrictions regarding the taking of game.*
- 5. Do not bring spearguns. Spearfishing in all parks and sanctuaries (with the exception of Biscayne National Park) is prohibited.*
- 6. Do not move or remove any historic artifacts.*
- 7. Above all, follow all regulations and restrictions posted in each area. Violators of park/sanctuary regulations are subject to civil penalties, including stiff fines, for each violation.*

For further information, contact: Florida Division of Tourism, 126 Van Buren St., Tallahassee, FL 32301.

S

BY JONI DAHLSTROM

Afew decades ago, aquaculture was hailed as the wave of the future. Proponents prophesied that farming the coastline would produce cheap animal protein (fish) in abundance to feed the poor and hungry of the world. Luxury products like salmon and oysters would be raised as economically and efficiently as chickens. Just as the wild taming of the prairies created a vast grainbelt, the coastlines were slated to become the barnyards of the future. The agricultural green revolution was about to be eclipsed by the blue revolution.

The wave hit the rocky beach of reality.

In hindsight, the problems encountered were predictable. Like animals farmed in close quarters on land, fish and shellfish packed into cages were prone to disease and variations in water quality. Like land-farms, sea-farms are capital and labor intensive. And from an environmental perspective, putting a sea-farm in the midst of an unspoiled channel isn't a lot different from plowing under Yellowstone.

The dream of aquaculture didn't go bust in the '80s; it simply sobered a little to the realities of a risk-prone capital venture. The proponents of aquaculture learned that raising massive quantities of fish isn't as easy as it looks. Modern land-based agriculture is the end result of thousands of years of experimentation, selective breeding, and accumulated knowledge, and it is still a long way from perfection. The complexities of water-farming won't be solved in a mere decade or two.

Aquaculture is a broad term that refers to raising plants or animals in water. (Technically, the same process in salt water is termed mariculture, but more commonly, all water cultivation is labeled aquaculture.) An aquaculture farm may control all aspects of the animal's life-cycle, as when fish are bred from domesticated stock and raised to marketable size in a controlled environment. Or it can concentrate on selected

parts of the life cycle; for example, juvenile fish may be transplanted to ponds to grow until harvest, while conversely young fingerlings may be released into the wild for eventual recapture. It also includes the harvesting of shellfish from man-made reefs.

The poor and wealthy nations of the world view aquaculture in significantly different ways. In China and the Philippines, for example, aquaculture accounts for almost 15 percent of the total protein available for the people. In these places, aquaculture isn't just a business venture, it's a basic food source.

In North America and Western Europe, aquaculture is more about profit than protein. In the U.S., the big news about aquaculture is that the 1989 Fortune Investors Guide recommended fish farming firms as good bets on the stock market even if the DOW remained lackluster. As Americans are eating more fish, the demand for aquaculture products is clear. Yet, in the United States, we import 70 percent of all our seafood. Only 10 percent is the product of stateside aquaculture. Where will we turn to meet the demand for items like domestic caviar, oysters, abalone and scallops?

Aquaculture is the only possibility. The stocks of wild fisheries around the world are static and declining. The species that have been successfully cultivated pretty much dominate their markets, virtually all trout and catfish sold in the U.S. are raised on farms. Thirty percent of all shrimp will be raised on farms by the year 2000. With only 10 percent of the total seafood consumed produced through aquaculture, there is clearly plenty of room for growth. It isn't difficult to grasp why the Fortune crowd is bullish on fish stocks.

Although the publicity surrounding aquaculture makes it sound like a new and marvelous invention, it has long been practiced by people wherever there is a good supply of water and fish. The Chinese were the first documented aquaculturists, starting at least several thousand years ago. They raised carp caught as juveniles in special ponds until they were large enough to market. The Egyptians practiced aquaculture at least as early as 1400 B.C. The early Romans raised oysters and kept eels in

ponds. Many coastal cities in Europe had learned how to promote the growth of shellfish on artificial structures, long before the time of the Industrial Revolution.

Modern aquaculture got a big push in 1733, when a German fertilized eggs in a dish and raised them under controlled conditions. For the first time, science could control the life cycle of fish from the point of conception to maturity.

One way that aquaculture differs from modern agriculture is that it has yet to become standardized. Each aquaculture project seems to be virtually custom designed for its particular location, and the tastes of the final consumer. In China, Israel, and India, where efficiency on a small scale is of paramount importance, aquaculture is most often viewed as a piece of a polyculture puzzle. Polyculture is the raising of several different types of animal in one body of water. In these countries, a single pond is home to duck or geese, and several species of fish.

The idea behind the polyculture pond is to maximize the yield, while using minimum energy and water. The droppings of the ducks and geese place nutrients in the water, indirectly feeding the fish; vegetable tops and scraps are also added to the pond. Each species of stocked fish is chosen to occupy a different area in the pond, and to feed on a particular type of food organism.

On a small, carefully managed scale, the system works beautifully. But, it doesn't expand well. On a large scale, raising a variety of products isn't efficient.

However, in light of declining worldwide seafood stocks, the idea of grow-your-own is being taken a bit more seriously, though it is practiced much differently in the industrialized countries. Norway, Scotland and British Columbia have been among the most aggressive in creating salmon farms with an eye toward exporting the end product.

For these projects, salmon are raised in huge pens in protected bays. The fish are fed a highly specialized diet of soybean meal, fish meal, and other nutrients designed to give the flesh good color and taste. At smaller operations, the fish are fed twice a day in

The writer/photographer team of Joni Dahlstrom and Adam Zeter are based in California. They are frequent contributors to Diving & Snorkeling magazine.

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SEA FARMING FLOUNDERS

Aquaculture even sounds good as a word, but like any business, it has its tales of woe.

Oysters are grown in baskets suspended underwater.



Photo by Glenn Allen



diving at the other, fit neatly (but *not* simultaneously) into Haldane's model. This is because those dive profiles are fitted to dissolved gas models. Unfortunately, the sort of activity undertaken by sport divers—multilevel, multi-day, repetitive diving—isn't. This is why sport divers have been bent using the tables and computers. This is why cautious divers have developed "fudge factors," like abbreviated bottom times and safety decompression stops, to make both Table and computer diving

Wienke, a physicist at Los Alamos National Laboratory. Wienke holds degrees in both nuclear and particle physics. The major portion of his work is classified Department of Energy stuff. Wienke first became interested in bubble mechanics while addressing problems in the cooling systems of nuclear reactors. There, bubbles forming in liquid sodium could interrupt flow patterns in pipes, an effect similar to that which occurs in capillary blood when bends occurs. When he became a diver, Wienke

DIVE TABLES Reexamined

BY ERIC HANAUER

Diving used to be simple. We followed the U.S. Navy Tables, remained within the no-decompression limits, and felt secure we would not be struck down by the bends. If anything ever went wrong, we knew it would be our own fault. Then diver computers arrived with multi-level adaptations of the Tables. Suddenly, we were pushing the limits of the envelope, diving profiles that would have previously been impossible. And a few of us began getting bent.

All versions of the Dive Tables, as well as all computer algorithms in use today, are based on research done by John Scott Haldane in 1910. That was 80 years ago, and lots of bubbles have since been blown. Haldane's research was based on dissolved gas theory. Remember when your Basic Scuba instructor used the Coke bottle analogy, about gas coming out of solution and fizzing when the cap was removed? After a few reckless dives early in my career, I spent some sleepless nights imagining those fizzies in my bloodstream.

Now a group of scientists tells us that Haldane didn't come up with all the answers. Their studies on the origin and growth of nitrogen bubbles will soon form the basis for a new set of diving tables. The problems they address are the gaps in our tables which aren't explained by Haldanean theory. Saturation diving at one extreme, and bounce

The dive tables are based on 80-year-old research, and a group of scientists think it's time some new theories were applied.

safer. You see, the Navy Tables were based and tested on the principle of a diver making one dive a day, at one level, with perhaps one dive later on the same day. That's the sort of diving Navy divers do. All other data was extrapolated from the original table. Usually it works, but sometimes it doesn't, and a single mistake can result in paralysis.

The new bubble mechanics theorists believe their approach, encompassing both free and dissolved gas phases, will result in a table which safely covers the entire spectrum of diving. And it will do the job without the use of fudge factors, except in extenuating circumstances like extreme cold, excessive work load, or poor physical condition. It is based on research done by David Yount and Richard Strauss in 1975, and additional work by Chris Lambertson, Tom Kunkle, Brian Hills, and Val Hempleman. Essentially, the bubble mechanics theory, or free-phase dynamics, is based on the assumption that micronuclei, or "bubble seeds," are always present in our body. Under certain conditions, the theory contends, these will grow into the bubbles that cause bends.

One of the more articulate spokesmen for free-phase dynamics is Dr. Bruce

continued to pursue the question as it applied to diving. Today, Bruce is an Instructor Trainer with NAUI, a Master Instructor with PADI, and an Institute Director with the YMCA scuba program. Serving on advisory boards for all three organizations, he pursues diving with the same intensity as he does his other avocation, ski racing. An interview with Wienke about bubble mechanics began with a review of Haldane's work.

To comprehend bubble mechanics, we must first examine Haldane's dissolved gas theory. Haldane, a British physiologist, saturated goats in a chamber to depths of 165 feet. He observed they didn't suffer bends if decompression was limited to half of ambient pressure. Since tissues apparently tolerate twice the pressure without symptoms, Haldane designed schedules limiting the critical saturation ratio to two in hypothetical tissue compartments. A "compartment" is merely a mathematical model, and does not directly correspond to any specific tissue in our bodies. Each compartment was categorized by its half-life, the time required for it to lose half (or gain double) its nitrogen. Fast compartments control deep, short dives while slower

(Please turn to page 52)

Eric Hanauer is an Associate Professor of Physical Education at California State University, Fullerton. His new book, *The Egyptian Red Sea; A Diver's Guide*, is published by Watersport Publishing Co.

SHOPPERS' CORNER



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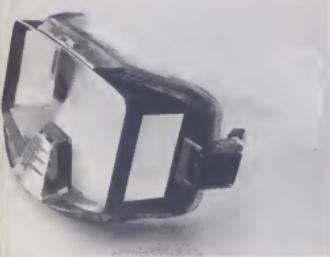


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SCUBAPRO Chromemoly Tanks are available in five configurations and four sizes; 60.6, 71.4, 75.8, and 95.1 cubic feet. These tanks can be purchased with or without valves.

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SCUBAPRO engineers highly recommend the installation of a tank boot on all SCUBAPRO tanks for stability as well as tank bottom protection.

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The advanced D350 has a new high cam demand valve lever, which improves flow rates at depth. Valve seat wear has been reduced even further through the use of new low compression silicon seat materials and a redesigned orifice angle. The cap has been redesigned with a stronger thread configuration.

The switch has been changed so the customer can choose from three different colored accent decals (blue, red and teal). The D350 follows the SCUBAPRO philosophy of over 25 years of continuing improvements of our quality products. See the D350 at your local Authorized SCUBAPRO Dealer.

SCUBA ARUBA



The fruit and vegetable market in Oranjestad.

BY M. TIMOTHY O'KEEFE

Most shipwrecks have an interesting tale to tell, especially for the people on them when Fate dealt black aces. But the *Antilla*, which sank in shallow water off Aruba, boasts one of the strangest. At the beginning of World War II, this brand-new German freighter supplied submarines patrolling the Netherlands Antilles located just off the Venezuelan coast.

Initially, Aruba was a declared neutral zone and the *Antilla* was free to dock there between missions. Allied subs, try as they might, could never locate the

M. Timothy O'Keefe is Editor-at-Large for the Florida Sportsman and a professor of journalism at Central Florida University.

vessel when it was in open water, so it became known as the "ghost ship." No matter, the Germans ended up sinking the ship themselves.

When the Germans invaded Holland, Aruba entered the war on the side of the Allies. The *Antilla*, anchored where she rests today, was ordered to surrender. For some reason, the police agreed to give the captain one day to think over their demand. When the authorities returned the next morning, the crew was lined up on the beach, ready to surrender. The ship was resting on the bottom. The captain had ordered the ship scuttled rather than let it fall into Allied hands. Divers should find out the name of that captain and erect a monument to him.

The 400-foot-long *Antilla* (also spelled Antila and Antilla) is one of the largest wrecks in the Caribbean. It also sits in very shallow water with parts of the superstructure still jutting above the surface. Maximum depth is only 60 feet, so it's a place to spend a lot of tank time.

However, the wreck is so big it's virtually impossible to inspect thoroughly on a single dive. Better to schedule several dives and sample one section at a time. Visibility generally runs between 50 and 60 feet but at times it can be murky due to surge.

The *Antilla* is completely intact and it's easy to make penetrations in the large compartments and cargo holds. From top to bottom, the wreck is festooned with bright sponges and corals that are ideal for portrait or macro photography. As a night dive, the *Antilla* is unsurpassed.

I thoroughly enjoyed penetrating the gloomy interiors, following ladders that lead nowhere and photographing my buddy framed in hatchways and doorways with lots of open water behind. Because of the shallow depth, the intactness of the ship and the abundant marine growth, I found the *Antilla* to be one of the easiest and most pleasurable wrecks to photograph anywhere.

My dive boat, operated by Pelican Watersports, was one of several that make regular trips to the ship, so there may be more than one boatload of divers on the wreck at any given time. But the wreck is so large, it's easy to find a private spot to explore or photograph.

However, if you prefer to explore Aruba's waters at your own pace, the person to contact is Romeo Croes of Native Divers. His one-man operation specializes in catering to only one to four divers. Using a 22-foot open boat powered by a 140-horsepower outboard, Romeo's not only able to quickly visit

*Aruba offers a diversity of
underwater attractions
and almost perfect
diving conditions.*





Diver prepares to make a night dive from shore.



the nearby sites, but also to trailer his craft to remote locations that very few divers ever visit.

I joined Romeo for another wreck dive, not another ship, but two sunken airplanes. Both were just offshore not far from the airport runway. The standard joke is their pilots landed a bit prematurely.

But according to Romeo, these were confiscated drug planes donated by the government to attract divers. They'd

been in the water less than a year.

It seems that planes arriving on Aruba without having filed a flight plan are automatically suspect. Officials immediately search and confiscate "tainted" planes plus provide jail accommodations for their occupants. What happened was that so many planes were seized, they were running out of storage room at the airport. The government subsequently auctioned off as many planes as it could. A small

twin-engine private plane and a large DC-3 that no one bid on were consigned to the deep.

The planes are shallow with the smaller one at only 20 feet. The larger DC-3 is closer to 40. They are located adjacent to each other so it's possible to view both on the same dive.

Already their shiny exteriors have taken on a mottled appearance as marine growth slowly begins to take hold. It's possible to swim inside both craft, even squeeze through the door of the small one. So far there isn't much growing overhead for exhaust bubbles to disturb. Since visibility was severely reduced due to surge, only about 25 to 30 feet, I spent most of my dive photographing the smaller plane since it stood out better.

Two other shipwrecks of note in Aruba are fascinating as much for their history as for their diving potential. The *California* off California Point Lighthouse on the north coast in only 30 to 45 feet of water. It will always be logged in maritime history as the ship that received but did not respond to signals from the sinking *Titanic*. Currents and choppy seas make this an advanced dive. The *Perdenales* is a section of wreck lying among coral formations at 25 feet. It's a good novice dive. The oil tanker was torpedoed by the Germans early in the war. She didn't sink so the U.S. military cut the hulk into three sections, leaving behind the torpedo-damaged middle part. The bow and stern sections were towed to the U.S. and welded together to create a smaller vessel which, ironically, took part in the Normandy invasion.

Besides wrecks, Aruba has many reef sites, but most are on its south coast. This is an area most dive operations seldom visit because of the travel time from the luxury hotels. This is where Romeo and his trailer boat come in handy. One of the best reefs, and also one of the farthest away, is off Baby Beach. It's a place to see sharks, sting rays, lobsters, morays, and large formations of elkhorn corals. Sea fans and gorgonians start at 60 feet. Because of its location at the tip of the island, there generally is good visibility (80 to 120 feet). The current is usually under one knot.

With more than 25 designated dive sites, it's surprising more people don't come to Aruba just to dive, but apparently the land attractions are just too appealing. Beautiful beaches, exciting casinos and excellent duty-free shop-

Holland Aruba
Mall in Oranjestad.



TRAVEL TIPS

Getting There

Aruba is quite easy to reach. From Miami, BWIA makes non-stop flights daily in the late afternoon, ideal for making connections from other parts of the country. BWIA is the airline of Trinidad and Tobago, and its friendly, efficient flight personnel provide a good transition to the Caribbean flavor. Air Aruba plans to begin flying regularly from Miami. ALM already does. American Airlines flies to Aruba directly from New York but also offers connecting service through its large San Juan hub. Continental also flies non-stop daily from Newark.

Where to Stay

Aruba's resorts are probably on par with any in the U.S., so choice isn't critical. However, in terms of the dive operations, Red Sail serves the Americana, and Pelican Watersports picks up guests at the Concorde Hotel and Casino and the Holiday Inn. Scuba Aruba is at the Palm Beach Hotel. The newly opened Sonesta hotel also has its own on-site dive operation. Of course, you don't have to stay at a specific hotel to use a particular dive operator. To contact Romeo Cores at Native Divers, telephone 34763 locally or 011-2978-34763 from the

United States.

Dive costs are fairly standard throughout the island. A two-tank morning dive is \$60 while a single afternoon tank is \$45. These rates include all equipment. Bring your own and prices are sometimes cut \$5 to \$10. Night dives are \$50. For hotel/dive packages and airline tickets, contact Maduro Travel, 1080 Port Blvd., Suite 100, Miami, FL 33132. Phone: (305) 373-3341.

Currency

An American dollar is worth 1.77 Aruban florin (or guilder). Prices are often quoted in both currencies. Dollars are readily accepted everywhere.

Electricity

Same as in the U.S., 110 volts, 60 cycles.

Documents

Valid proof of citizenship. A passport is best.

Departure Tax

It's a steep US \$9.50 per person. Don't spend all your money before you leave.

For More Information

Contact the Aruba Tourism Authority, 521 Fifth Ave., 12th Floor, New York, NY 10175. Phone: (212) 246-3030.

\$

ping are just too much competition for the wrecks and reefs, so most visitors make diving only a part of their vacation.

Only 20 miles long and six miles across at its widest point, Aruba is situated just 15 miles off the Venezuelan coast. Aruba is no longer part of the Netherlands Antilles group, but is a separate entity within the kingdom of the Netherlands.

Weather in Aruba, like the rest of the Dutch ABC's, is almost always perfect, varying little from the average of 81 degrees, yet it never seems hot thanks to the constant trade winds. Rainfall is limited, only about 17 inches a year. Aruba is also located well away from the normal hurricane path.

This isle of perpetual summer uses "One Happy Island" as its slogan, and the islanders truly live up to it. They are people descended from the Dutch and intermixed with European stocks to create their own unique culture, including a special language called "papiamento," a blend of English, Spanish, Dutch and Portuguese. But not to worry, almost everyone speaks several languages, including English.

Happily, Arubans retain the Dutch traditions of politeness, cleanliness and efficiency. Most importantly, they are genuinely friendly people who welcome tourists. Their brightly painted buildings with colorful orange roofs reflect the charm of the Dutch homeland. Offset against a deep blue sky and turquoise green water, the dwellings sometimes seem too toy-like to be real.

Where neighboring Bonaire and Curacao have to scrape for every grain of beach sand, Aruba's beaches seem to stretch on forever. They are some of the cleanest and brightest in the Caribbean. And, as would be expected, they are well girded by major luxury hotels like the Concorde Hotel & Casino, the Golden Tulip and the Americana.

Until recently, shopping in Aruba was on a relatively minor scale but construction of several major malls in the main city of Oranjestad probably puts Aruba's offerings on par with Curacao, long famed as a shoppers haven. Concentrated along Nassaustraat, the storefronts are painted in pastels bright enough to belong in a modern art gallery. Everything you buy will be duty-free, just keep in mind it's con-

sidered bad manners to haggle over prices.

While the beaches and shopping district of Oranjestad are the main hubs, there is still a great deal to see on this tiny island. It's easy to drive around because the roads are good, but many are unmarked, which creates a slight problem. You will have to consult local road maps frequently, or bearings can be taken from the ever-present divi-divi trees. The divi-divis (locals say the trees grow sideways instead of up) are all bent entirely in one direction by the easterly trades. This means they all point southwest.

A tour of Aruba must include the rugged north coast, site of the largest and most perfectly formed natural bridge in the Caribbean. Some people have been known to dive here, but in that surge they have to be crazy. The best time for photographing the bridge is late afternoon. At two inland locations, Ayo and Casibari, even odder natural curiosities can be found. These are unusual rock formations that mimic the shapes of various animal heads. There are also Indian petroglyphs at Ayo.

Curious man-made objects can be found as well on a tour of Aruba. Along the doorways and windows of many old cottages, ornate carvings of flowers and strange symbols formed in cement can be seen. Surprisingly, these are hex signs, created to ward off evil spirits in this very Christian community.

Across from the Concorde Hotel & Casino is the Old Mill, a full-sized windmill brought over from Holland. It's still in operation, not as an energy source but as a very popular and unusual restaurant. Nearby is the Palm Beach area, a hotbed of windsurfing activity. With a 16mph trade wind, this is a superior place to put in some board time or learn how to windsurf.

Another interesting stop is the Spanish Lagoon where pirates hid their booty and where some treasure may still be waiting to be found. Not many people realize it, but gold mining was an important industry on Aruba. Gold was discovered in 1825, and although more than 3,000,000 pounds were mined, operations shut down in 1916 because they were deemed no longer economically feasible. A huge oil refinery, at one time the largest in the world, was built near San Nicolas to boost the island's prosperity. Now tourism is the major industry, and tourism is booming. So well, in fact, that the number of hotel rooms should double in the next two years. On the other hand, maybe it's just as well most visitors don't spend their entire vacation diving. There might not be enough room underwater for everyone.

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SEA FARMING

(Continued from page 17)

summer and once a day in winter. The larger operations constantly monitor temperature and chemicals in the water with electronic equipment. The information gathered is analyzed by a computer program that calculates precisely the right time and amount to feed a particular pen of fish. The food is then automatically distributed to the tanks through a system of hoses.

Transporting the fish to market is equally scientific. The salmon are usually stunned by an electric shock or rapid chilling with ice. The fish are immediately cleaned and packed in ice and shipped by airfreight to their final destination. This takes only 12 to 24 hours for a fish to reach the consumer. Freshness is obviously a big selling point for farm-raised fish.

But as in land-farming, initial success is sometimes the greatest enemy. British Columbia placed a lot of hope in salmon farming to boost a lagging economy. For five years, the Canadian government subsidized and publicized the infant salmon industry to get it off the ground. Finally 1989, the year of the big pay-off, rolled around. A crop of 14,000 tons of salmon was produced, up from 6,400 tons the previous year. The trouble was, Norway also had a record production year and so did Canada's own capture fishing fleet. The market price of salmon plunged from \$4.45 a pound in January of '89 to \$2.35 a pound in August. Fifteen of 79 companies went bankrupt, with many more in serious financial trouble.

Of course, nature also gets to deal her hand to the ocean farmer, just as she does to the corn farmer. Even with all the fancy computerized equipment available to monitor every aspect of the young salmon's environment, problems arise. Disease is the nemesis of all live stock rearers. Worse yet, diseased farmed stock poses a threat to the wild stock. In Norway, farm salmon carried a virus into 95 separate drainages. The particular virus did not harm the salmon, but was fatal to rainbow trout. To protect the native trout fishery, it was necessary to treat all of the drainages that held contaminated fish, poisoning the salmon and trout to prevent further spread of the disease. The areas were then restocked with healthy fish. To prevent this type of incident, most state agencies in the U.S. do not permit the importation of eggs or fry across state lines. They further restrict the movement of eggs from one drainage to another.

This compounds another problem that aquaculturists face, which is the

procurement of fish eggs or fingerlings, both referred to in the industry as seed. With the industry not just growing, but mushrooming, acquiring juveniles has become quite a problem, especially for Norway's huge farms. Though their salmon are usually large enough to market at an age of about 18 months, and a little over one and one-half pounds in weight, many farmers hold on to the stock until it reaches a weight of nine pounds. They would rather keep their current stock, putting off the return on their investment, than run the risk of not being able to purchase replacement juveniles when needed.

This problem of fry leads to the primary argument raised against aquaculture. It all boils down to diversity. In the long run, relatively few species are likely to be profitable to raise commercially; thus the wide range of seafoods now available in shops and restaurants may be severely reduced. No one is likely to figure out a way to commercially raise swordfish at a profit, so it will never be cheap and readily available. As fish caught by traditional means continue to rise in price and farm-raised fish become cheaper, fish selections may in time look like the meat shelf of the grocer who commonly stocks only beef, pork and chicken. Tomorrow's catch of the day may be no more varied than salmon, trout and catfish.

It is a realistic fear, because many marine species won't reproduce in artificial conditions as they presently exist. Experiments carried out at HUBBS Marine Research Center in San Diego managed to induce spawning and raise fingerlings of white seabass (this project was seen primarily as a restocking program, so the cost and difficulty of actually raising fish to market size was not addressed), but the same group had little success with kelp bass. Halibut have proven difficult to spawn in controlled

conditions, let alone to raise to a reasonable size. Rockfish breeding programs came up blank.

There is the secondary problem of where to put fish farms. As in almost every aspect of American life, everyone wants more product, but they don't want the production-line in their backyard. Puget Sound was initially considered an ideal location for salmon farms, with similar characteristics to British Columbia. But, once farms were established and residents saw their pristine waterway fenced, penned, and tamed by a fish factory, they told the fish farmers to take their pens elsewhere. The residents of Puget Sound have managed to limit the number of salmon farming operations to a paltry 13.

The concerns are valid in many ways. Fish create their own brand of sewage. Shrimp farms in Hawaii are expected to increase production over the next few years by about 10 times. If they achieve that level, the shrimp farms will produce as much sewage as 350,000 city-dwelling humans, one-seventh of the population of the Hawaiian Islands. Of course, these are huge shrimp factories covering many thousands of acres, but that doesn't change the fact that large, dense fish farms affect water quality.

On the other hand, aquaculture does relieve pressure from wild stocks by taking up some excess demand and creating price competition. In many ways, fish farming could be seen as a way to restock the oceans.

However, experience tells us that replenishing programs almost never work as well as hoped. Those who watched the fences go up on the Great Plains knew changes would take place. It depended on who was doing the looking whether those changes were good or bad. We might want to pause before we fence, tame and cultivate the ocean, because once it has been done, the open seas will never be the same. \$



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ARUBA

Seafood Sampler

With people of over 40 different nationalities and 100 restaurants competing for their business, Aruba is a dining paradise. Like the language of Papiamento, Aruba's cooking is a blend of many cultures, but there are also some unique locally inspired dishes found almost nowhere else.

MII CUSHINA RESTAURANT

Mi Cushina (translated "My Kitchen) is

a new restaurant that specializes not only in local cuisine but Aruba history. Owner Wijki Maduro has turned his former supermarket into a true gourmet's delight while at the same time furnishing the dining room with many rare artifacts and documents.

For instance, he shows how aloe was crushed on the old aloe plantations a century ago, displays the device used to haul cactus to make fence and even has an old clock with only the hour hand. Wijki says there never was a minute hand; in the past people just didn't worry that much about minutes.

Mi Cuchina is where I first tasted iguana soup, a rare treat on any Caribbean island. It tasted like—what else—chicken. Quite good. However, I haven't included that recipe, only the seafood dishes you can easily prepare at home. Iguana doesn't quite qualify.

KERI-KERI

This is a delicious, spicy, flaked fish recipe, a wonderful thing to do with fish that may have been in the freezer too long or when an excessively oily taste needs to be hidden. Keri-Keri is extremely simple to make. The ingredients are:

1½ pounds cooked and flaked fish
1 green pepper finely diced
1 tsp. fresh or packaged oregano
Curry to taste (but be careful not to overpower it)
Paprika for color

Sauté all the ingredients but the fish in vegetable oil until the green pepper is tender. Add the flaked fish and continue to sauté slowly for a few minutes longer. Then mix together in the shape of a loaf and serve.

Chef Joseph Munzenhofer, opposite, co-owner of the Buccaneer Restaurant, presents a dish. Fishermen on Aruba unload their catch.



FRIED LOBSTER

A change from the usual broiling, which tends to dry out this wonderful delicacy.
1 large lobster tail shelled and cut in half from front to back.

**Season with salt and white pepper
Add a few dashes of Worcestershire
Sauce**

Fry the lobster meat in butter until done and discard the butter. In another pan, saute some sliced onion, diced green pepper and garlic, if you like, in butter. Pour over the lobster and serve with rice.

STEWED SHRIMP

This is not a stew in the typical sense, but excellent nonetheless.

**15 medium shrimp
1 onion chopped
1 green pepper chopped
Soy Sauce**

Oyster Sauce (available in some supermarkets or any Oriental food store)

Saute shrimp with onion and green pepper in butter, then add salt, soy sauce and oyster sauce to taste. Simmer a few minutes more but be careful not to overcook. Serve over rice.

THE BUCCANEER RESTAURANT

This establishment is so popular it won't take reservations and is closed on Sunday, one of Aruba's busiest dining nights. The interior is as unforgettable as the food. One dining room is flanked by a 5,000-gallon aquarium and the other by 12 porthole-size tanks. Fish nets and turtle shells hang from the ceilings. The idea is to give the impression you're inside a sunken ship. In the low lighting, the effect works well.

Co-owner/chef Joseph Munzenhofer has been a cook since he was 14. One

of the secrets of his restaurant's success is the fact that Joseph is always in the kitchen preparing and overseeing. The waiters and waitresses work as diligently as he does, so the service is excellent.

For an appetizer, I had the best escargot of my life. The snails were served in a rich creamy sauce so good I could have made a meal of nothing else. In fact, the escargot would make a wonderful sauce for a plate of angel-hair pasta. The seafood dishes are prepared just as carefully. Some have been slightly modified for easier preparation.

SHRIMP PERNOD

**35 to 40 medium shrimp
1 cup hollandaise sauce at room temperature
1 cup veloute sauce (fish stock to which butter and flour have been added for thickening)
1 dash Pernod**

Boil shrimp in water seasoned with salt and lemon juice. Combine the sauces over heat and stir; allow them to become warm, but not too hot or they will break down. Add a dash of Pernod, being careful not to overpower the sauce. Add the warm shrimp and serve. Serves three.

STUFFED SWORDFISH

In this dish the fish isn't stuffed in the traditional sense. The stuffing is served on top of the fish like a sauce.

**Swordfish fillet
1 cup veloute sauce
½ cup cooked crab meat and chopped cooked shrimp combined
Bay leaf
1 cup hollandaise sauce**

Selection of the pan for poaching the fish is important. The pan should be a small one, just large enough to hold the

fish. Bring a mixture of $\frac{1}{2}$ water and $\frac{1}{2}$ white wine to a boil. Pour just enough over the fish to cover it. Add salt, bay leaf and chopped onion. Boil for 3 to 4 minutes. Carefully remove fish and place on a serving plate. While the fish is cooking, warm the veloute sauce, adding the cup of shrimp and crab meat. Spoon shrimp and crab over top of swordfish, then cover with hollandaise sauce.

PAELLA ARUBIANA

This traditional Spanish dish can be adapted for available seafoods. It will serve four people.

Approximately $\frac{1}{4}$ cup each of the following 4 ingredients cut into chunks:
**Chicken
Shrimp
Octopus or squid or both
Smoked pork
White wine
Fish stock
 $\frac{1}{2}$ cup each of chopped onion and green pepper
1 stalk of celery, chopped
Curry powder, garlic salt & pepper
Yellow or brown rice**

Saute all the meat and fish and the onion, pepper and celery in a pan with oil or butter. Add enough fish stock and white wine in equal proportions to cover. Season with curry powder, garlic and salt and pepper to taste. Cook slowly for three or four minutes. In the meantime, cook yellow or brown rice in chicken stock, allowing one cup of cooked rice per person. Drain the seafood, meat and vegetables, and add those ingredients to the rice. Mix thoroughly and transfer to a serving dish. Garnish with cooked shrimp, asparagus and peas.

By M. Timothy O'Keefe

Miss Behavior's Guide to GETTING THERE...

Acivilized society has rules for a reason, one supposes, and right-minded divers obey them. Still, I and others wish the powers-that-be wouldn't invoke Murphy's Law so often—at least not while we are traveling.

Recently, this ordinarily unflappable scuba journalist was fairly flapped when a gate agent at Miami International said that a particular flight connection to a small, not-yet-too-commercialized Caribbean paradise had been missed. As you can well imagine, I was not pleased to hear "you can't get there from here—at least not until Thursday" on that particular Monday afternoon. With all due respect to the Dade County Tourism Promotion Council, Miami is not where your Miss Behavior wanted to be at the moment—not with an assignment to cover a different destination and a deadline approaching faster than you can say "remaining no-decompression time."

Stranded sans word processor, your favorite fountain of advice pestered the ground crew about the whereabouts of a deep-blue dive bag, last seen in Philadelphia at 6 a.m., then settled back to take in the diverse human scenery that makes Miami airport unique. With one eye on the lookout for Don Johnson, your roving reporter scanned the miles of ticket counters—with departures to every Caribbean destination imaginable. WARNING: Miami airport could be a dangerous place for anyone with half a sense of adventure and a credit card.

Yes, most divers eventually tire of a steady diet of "backyard" diving. The trend today is travel. Even people who live in leading dive destinations like New Jersey are packing up their gear and going somewhere new. (In their case, that "somewhere" might be New York or Delaware, but it's a start.)

Don't let this introduction give you the mistaken impression that dive travel is fraught with perils, missed connections and misplaced bags. Miss B. has covered countless miles without any offense or experience more inconvenient than being held up for aircraft maintenance in Guam long enough to read a Clive Cussler novel. The book was at least as interesting as the vacation, and most of the passengers felt better knowing that the brakes would probably work.

Still, when you plan to leave your native soil, I suggest a Boy Scout refresher course because, dear dive

Cathie Cush is a NAUI instructor and free-lance writer. Her "Miss Behavior's Guides" appear irregularly in Scubapro Diving & Snorkeling.

traveler, someday that legal eagle Mr. Murphy may catch up with you—so be prepared.

Dear Miss Behavior,

The dive destinations I'm reading about are so tempting that I'm drooling over the pages of my *Diving & Snorkeling*. But when I tried to set up a dive trip, I was told I'd have to take out a second mortgage or ransom my firstborn. I wouldn't mind, but my wife is pretty touchy about what we do with the kids. What's a dollar-conscious diver to do? And can I get a clean copy of the latest issue? The pages of mine are all stuck together.

—Wanderlusting

Dear Wander:

Don't give up the ship. There are inexpensive ways to travel, and they don't all involve trying to conceal yourself as cargo or dropping to the floor and giving some sadistic drill sergeant "50."

Start with the places non-divers go. Non-divers aren't all that bad, if you don't spend too much time around them, and they do know how to choose easy, relatively inexpensive travel destinations with gorgeous beaches. This doesn't guarantee great diving, but it's usually a good bet for getting wet. These places usually offer lots of available flights, a wide variety of accommodations, T-shirt shacks and plenty to do if you happen to be traveling with ninnies—er, non-divers.

These popular destinations also have another attractive advantage: they are served by major tour operators. These enterprising organizations book blocks of rooms at several hotels, then charter planes to the destination. Because they can guarantee the number of travelers, they can cut a better deal and, theoretically, pass substantial savings on to you. This usually works well, as long as you can arrange your vacation around their departure dates. To arrange diving, have your travel agent call one of the shops in SCUBAPRO's store directory. The biggest drawbacks to charter travel are 1) the company can cancel the package if it can't fill the plane, and 2) the complimentary rum swizzle upon arrival is usually lukewarm. On the other hand, since most of your fellow travelers will be non-divers, they'll think you're the coolest thing since *The Abyss*.

A travel agent can be your best buddy—and it won't cost you a dime. Agents make their commissions from the airlines, hotels and car rental agencies. Cynics among you might immediately conclude that the agent has a vested interest in driving up your bill to get a bigger chunk of change. That may be so—but the fact that you can call around for the best price keeps them pretty honest. Besides, if you're sitting at home because you

can't afford to get to the Keys, they're not making any money. Of course, it helps if the agent speaks "Diver-ese," and can translate simple phrases like "I'd like to book a two-tank morning dive" and "I need to rent a regulator."

Dear Miss Behavior:

I don't trust these airline people. Every time I ask how much a ticket costs, they tell me something different. Are they naked or do they think I am?

—Infrequent Flyer

Dear IF,

It all depends. On most flights, all that meets the eye are first class, business class and the back of the plane where the rest of us sit. But there may be as many as two dozen different booking classes. The price of your flight is determined by when you fly, when you return, how long you stay, how far in advance you buy your ticket and how much money you're willing to lose if you change your plans—as well as by the number of seats in that particular booking class that are available on a given flight. In other words, you can save some money if you're willing to travel Monday to Monday instead of Saturday to Saturday, and even more if you can book your trip a month or more in advance.

The hitch is this: despite technological breakthroughs, mind reading skills are sadly underdeveloped. It's up to you to tell the travel or airline agent what matters more to you—the almighty dollar or the ability to change your seahorse in midstream. The best deals usually are APEX (advanced purchase excursion) fares, although—surprise!—these have the most restrictions.

Other than its impact on your wallet, your fare doesn't make a difference. You get the same service and eat the same food as everyone else in your cabin class—even the guy in the seat next to you. But if you told him you paid a third of what he did for the same flight, you'd probably ruin his vacation. And he's a lot bigger than you. So let's keep this between us, okay?

Dear Miss Behavior,

In the last two weeks my dive bag has been to Florida, Fiji, Finland, the Farallon Islands and, finally, home. My camera bag is still circling the globe. I had a great time in the Caribbean, but I think I would have enjoyed it more if I hadn't spent my food budget on mask, fins and snorkel. And after a week of wearing it around the clock, my sweatshirt was a bit ripe. I'm ready to bag traveling.

—Luggage Loser

Dear Loser,

All is not lost. A baggage handler for a major airline's New York operation recently estimated that the organization loses about 200 bags a day. When you consider the number of people and number of flights, that's really not a lot. I know, I know. Your chances of getting bit by a shark are greater, but there's no consolation if it's your bags that wind up in Luggage Limbo (a large warehouse near JFK airport) or, worse yet, get sold to one of the companies that auctions off unclaimed baggage. The good news? You might be able to buy back your favorite Stab Jacket at the company's scuba equipment auction in March.

AND BACK AGAIN

BY CATHIE CUSH

Illustration by A.J. Toos



To be fair, Miss B. has seen airline employees climb into baggage bins looking for pieces of luggage that had adopted different travel schedules from their owner's. The airport that mishandles the bags gets penalized, so handlers do everything possible to get your luggage where you're going.

Still, you should be prepared in case all your best efforts fail. Keep critical items with you (cameras, jewelry, passports, credit cards—I shouldn't have to tell you this). In your carry-on bag, keep a change of clothes and a bathing suit, so you're not stuck in Cozumel in your winter-weight cashmere while you're waiting for your bags to arrive. One buddy team I know splits their dive gear between two bags, so if one suitcase is delayed, each diver at least has some of his/her equipment.

If your bags are delayed, the airline *may* decide to reimburse you the cost of renting dive equipment or whatever else you might need until you get your bags. But if you don't ask, they won't offer. If your goods are gone for good, the airlines will cover a maximum of \$1,250 on domestic flights and less on international, unless you have declared a higher value and paid a premium up front.

Not that Miss Behavior doesn't trust a bunch of probably underpaid individuals who spend all day humping suitcases around the tarmac and watching with envy how the other half travels to exotic dive destinations that they'll only dream about...but, locking luggage might not be a bad idea. And expensive video and camera cases with "Steal Me" and "High Black Market Resale Value" decals all over them are probably best left at home. I pack everything into a salt-encrusted backpack that hasn't been washed since the early 1970s and doesn't look like it could possibly contain anything of value. This bag also helps me get through customs fast. Customs agents hesitate to touch it, much less go digging through it.

Dear Miss Behavior:

Had a great...trip...I think.... Such a fog...lot of diving...need another vacation....

—Zzzzzzz

Dear Zzzzzzz:

Jet lag ranks right up there with childbirth and dental pain as one of the most excruciating sensations known to humankind. That little venture down to 130 feet off the Cayman wall was nothing compared to the disorientation you'll experience after crossing several time zones to take in some Indo-Pacific sights.

You could, ho-hum, limit your travels to tropical spots within a time zone or two of your own. But you didn't become a diver because you have no sense of adventure, and diving gives you a great excuse to see parts of the world you might not otherwise visit.

Jet lag is like the common cold. There's no cure, but everyone and his third cousin has an idea about how to lessen its severity. Some suggest a pattern of exposure to bright lights to help change the body's clock; others say dietary changes will do the trick—eating high-protein breakfasts and lunches and high-carbohydrate dinners. One of the toughest things about fighting jet lag is that you have to start thinking about it three or four days before you leave. Going west, eat lightly on the third day before your flight, eat heavily the next day, then lightly again the next. Eat heavily the day you leave, and drink plenty of caffeine (cola, coffee, tea) before noon. After that stick to decaffeinated drinks. Going east, eat heavily on the fourth day before you leave, then eat lightly. On the plane, drink plenty of caffeine.

In either direction, sleep as much as possible and

drink plenty of water to avoid becoming dehydrated from the cabin's dry air. And try to stay awake once you get where you're going, especially if it's your vacation destination.

Divers who are in the air five hours or more should be cautious about diving too soon after arrival. Between travel fatigue, dehydration and the low-pressure/high-altitude environment, a body may be ripe for tiny bubbles. And a weary mind may not be on its toes, so to speak. If you're spending as much time underwater as you are on the surface, experts recommend a "decompression day" midweek to off-gas a little. And the current wisdom says no flying within 24 hours after diving, even if you learned back in the old days when "D" divers could fly.

If you've crossed enough time zones to get to say, Truk Lagoon, you'll be pretty much shot for a few days after you return home no matter what you do, particularly if home is at the end of an eastbound flight. If your job involves anything more demanding than intensive dream research, you might want to take jet lag into consideration when planning your vacation schedule.

Dear Miss Behavior:

Two airport guards led my buddy away at gunpoint, and I haven't seen him since. Could you please tell me more about the strange customs in this country so I don't offend anyone like he must have? I didn't like the looks of that hallway....

—Frightened in Fiji

Dear Frightened:

Etiquette infractions punishable by fine or imprisonment in some countries include removing corals, shells and other items upon which many of these island nations base their tourist trade. A piece of black coral might make a fine souvenir, but is it really worth the \$25,000 fine the Cayman government wants if they find you have some? And while some governments look aside while divers take live shells for their collections, do you really want that dead thing in your suitcase for a couple of days?

Airport security is another area to be aware of. You know that you have absolutely no intention of hijacking the plane and taking it to Cuba (although some say the diving there is excellent), but the guards don't. Miss B. once was delayed at a Mexican airport while two guards argued about the fate of her relatively innocent Swiss Army knife, which she carries in her purse in case a wine bottle might need opening. Apparently the guards decided that your 5-foot, 3-inch reporter was not sufficiently menacing, as I still have the knife, but now I pack it in my checked luggage.

Dear Miss Behavior:

On a recent trip to the Turks and Caicos, the visibility must have been close to 200 feet—but you'd never know it from my photos. Do I need a different strobe?

—Asa Iso

Dear Photographer:

Airport security people swear that their X-ray machines won't damage film under 1,000 ASA, and the problems Miss Behavior has had with her photos can't be blamed on X-rays. But most of the pros do use lead-lined bags, available from any photo shop, to protect their film from the potentially fogging effects of the X-rays. If this is something you're going to lose sleep over, keep in mind that some airports X-ray checked baggage as well as carry-on.

Dear Miss Behavior:

I don't know what hurts worse—my elbow or my wallet. So I stayed down there a little longer than I should have. Can you blame me? The best way to keep the cost-per-minute down is to spend as much time as possible under water, right? But for this, must I get hit with a bill for more than I make in a year?

—Sick in Saipan

Dear Sick:

You should have known better. If you insist on getting yourself bent, at least do it near a chamber. Chamber treatment can be expensive enough without adding the cost of air ambulance or helicopter evacuation to your bill. A bad hit in the islands can run \$30,000 or more—and a lot of insurance companies won't cover you outside your country of residence. That means the nice people who are in a position to ease your pain will want cash. If you talk nice, maybe they'll settle for a credit card. And you won't be in much of a position to bargain.

Getting even slightly sick on vacation is a drag. When you travel, make sure you have any prescription medications you need, along with the prescriptions in case you have to do any explaining, and plenty of basics, like aspirin, no-drowsiness decongestant, anti-motion-sickness medicine if you take it, and Pepto Bismol.

Keep in mind that a lot of places we call paradise are really severely underdeveloped Third-World countries, and many diseases we normally don't think about still are rampant there. When you book your trip, find out what vaccinations you might need, and make arrange-

ments early to get them. Some inoculations need to be given several weeks before you depart, and you may need to contact your county health department to find a specialist in infectious diseases who can give you the shots.

Dear Miss Behavior:

The Pacific is really gorgeous. I just wish I knew what it looked like beneath the surface. And I can't wait to see some of the island. From the air it looked beautiful.

—No Passport in Ponape

Dear Passport:

The ol' job ain't over till the paperwork's done, and if you don't bring it with you, you can't even get started. A driver's license or a Xeroxed copy of a birth certificate just won't do when a country requires proof of citizenship. You can apply for a passport at your local post office, or at the passport office in most major cities, and it's a good idea to apply a month or more before you plan to leave.

You'll also want your C-card and your Diver's Passport. You'll need the first to dive at all, and the second, if you can prove some experience, might get you to more interesting sites. Although more and more dive operations in heavily traveled areas are requiring logbooks, there's no substitute for looking like you know what you're doing.

The last, and possibly most important, thing to bring on your dive vacation is your sense of humor. It can go a long way toward making any trip more enjoyable. \$

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Eduard Montague

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8. (A) Do you subscribe to SCUBAPRO Diving & Snorkeling magazine? We publish four times

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As a matter of course, we don't accept advertising in SCUBAPRO Diving & Snorkeling that has no place in a diving magazine. We're proud of our advertisers and the products being advertised.

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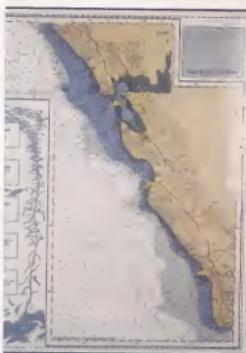
CITY _____

STATE _____

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1. A. 18 or under
B. 19 to 30
C. 31 to 50
D. over 50
2. Male Female
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B. Tennis
C. Pleasure boating
D. Hunting/shooting
4. Yes No
5. Yes No
6. Yes No

7. Yes No _____
8. A. Yes No
B. Yes No
9. A. Excellent
B. Good
C. Disappointing
10. _____
11. Yes No _____
12. _____
13. Yes No
A. Yes No
14. Yes No
15. A. 4 or less
B. 5 to 10
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16. A. Yes No Don't know
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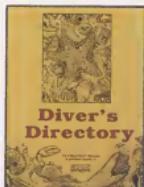


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Diver begins
descent to Gulf
Trade which is
covered with
marine life.



BY HERB SEGARS

So, This is **NEW JERSEY**





Tubularian hydroids grow on pilings, buoys, and shallow wrecks. Oyster drill, below left, are common in New Jersey waters.



To the unknowing, the diving in New Jersey may not rival anyplace, but those who dive here are quite content.

When it comes to dive vacations, New Jersey may not be among the top 10 destinations; it may not even be in the top 100. Yet, for those who dive in New Jersey regularly, the experience becomes as addictive as diving in any other part of the country. I would find it very difficult to move away, never again to experience diving in my home state. What is the lure that attracts divers to New Jersey where there are no guarantees of good visibility, warm water, colorful marine life or calm seas?

The waters off New Jersey provide varied opportunities for sport divers. For those on a limited budget, there is beach and inlet diving. During the summer months in these shallow waters, divers can regularly find tropical fish that have been caught in the Gulf Stream and swept northward. This past summer, the inlets were filled with butterfly fish, small damselfish, grouper and blowfish. A friend found a small blue angelfish and a juvenile French angelfish, both of which are now in her home aquarium. The thrill of having these tropicals in our local waters is gratifying to underwater observers and photographers.

Lobster hunters pursue their quarry

(Please turn to page 60)

Herb Segars lives close to the New Jersey coast and often writes about and photographs the wrecks lying off her shore.



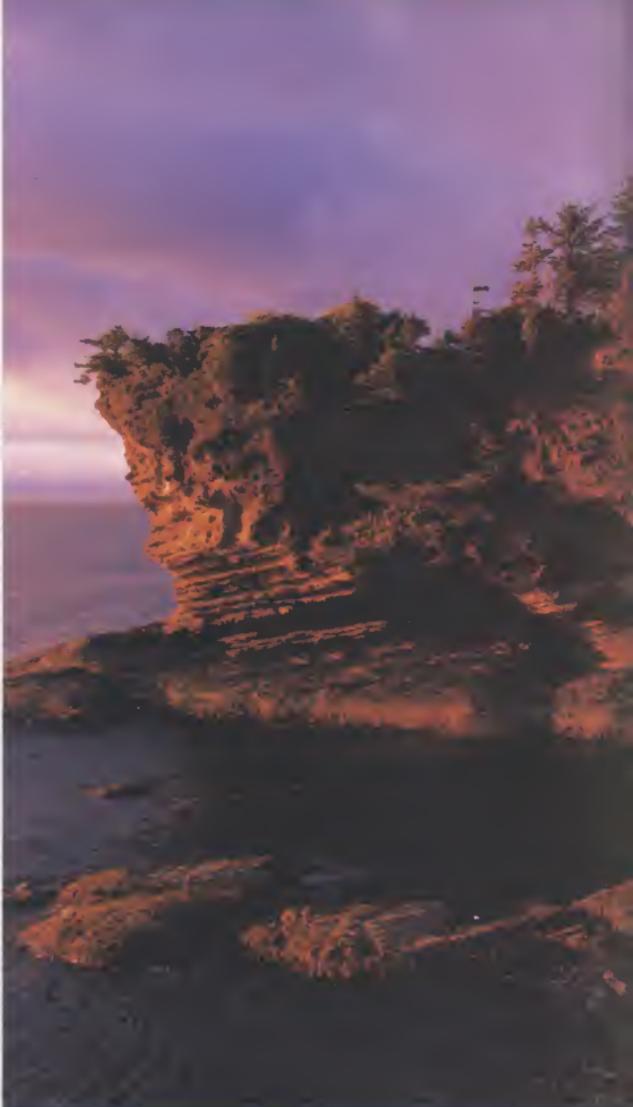
The cliffs at Cape Flattery, Washington, show the effects of wind and wave.

The spotlight continues to shine on the Pacific Northwest. This summer's Goodwill Games will attract national attention to Puget Sound's breathtaking surroundings. Snowcapped mountains, verdant forests and scenic waterways are all within sight of the city of Seattle. One highlight likely to escape all media attention is the wealth of jewels hidden beneath our emerald sea. A dazzling array of invertebrates carpet the substrate, in every color imaginable. Giant octopus, sea anemones, urchins, starfish and nudibranch species grow larger here than anywhere else in the world. The Northwest waters provide a tremendous variety of dive possibilities, from tranquil, shallow reefs to shipwrecks and dizzying drop-offs plunging into mysterious, colorful kingdoms.

Like blood vessels emanating from a major artery, a complex network of inlets, islands and coves extend from the Pacific Ocean several hundred miles into the heart of western Washington. Most of the state's population and commerce are centered around the harbor cities of Seattle, Tacoma, Bellingham, Port Angeles and the capital city of Olympia. Protected from the giant waves and surge typical of the open Pacific coast, over 2,000 square miles of water surface make Puget Sound one huge, aquatic playground.

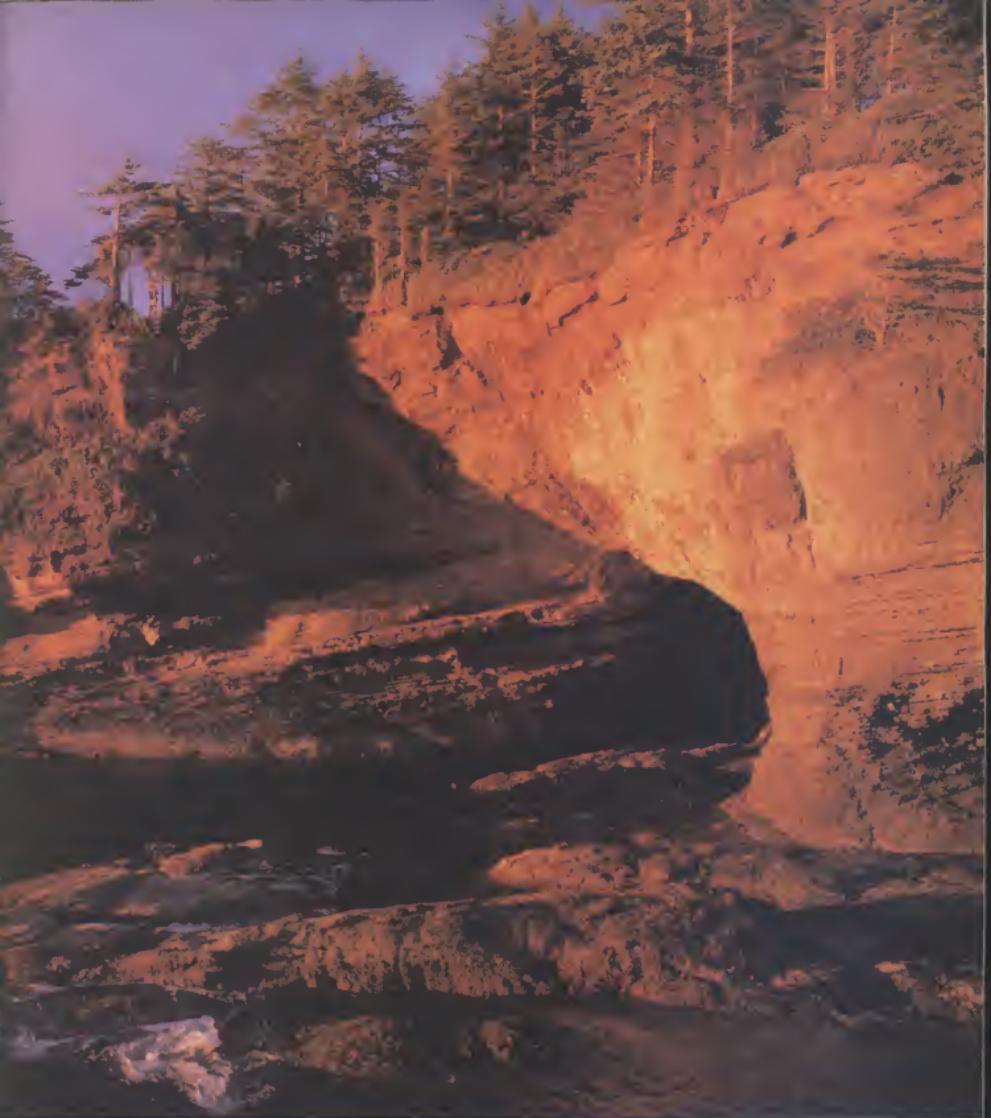
What might be surprising news to out-of-state divers is no secret here. The air and water temperatures are mostly cold, but the diving is hot! More than a quarter-million divers have been certified in the Evergreen State. Seattle alone has more than a dozen professional dive stores and an equal number of dive clubs. Washington has one of the largest diving populations in the country, behind California, Florida and Texas.

As in all diving, aquatic adventures here require a certain amount of preparation. Certified divers from warmer waters would be wise to dive with operators familiar with the area before attempting to dive on their own. There are several excellent guidebooks available that detail many wonderful dives. They come complete with maps,



F. Stuart Westmorland is a Seattle-based writer and photographer who specializes in material on the Pacific Northwest.

Exhilarating



WASHINGTON

BY F. STUART WESTMORLAND

current and tide corrections, plus a list of hazards likely to be encountered. Betty Pratt Johnson's *141 Dives* has been the authoritative dive guidebook for the last decade. A welcome new entry in the field is Steve Fischnaller's *Northwest Shore Dives*, a well-organized guide with some extra information worth mentioning. Fischnaller spent hundreds of hours mapping near shore currents, coming up with data significantly different from that published in current and tide tables. Consistently safer dives are now possible, thanks to Steve's time corrections. Dive clubs are another excellent source of local information, and a number of clubs are receptive to new or visiting divers.

During the Ice Age, massive glaciers moved through this region carving deep channels in the rock surface as they receded into Canada. This radical erosion, followed by a rise in sea level, accounts for the Northwest's irregularly shaped coastline and plunging drop-offs close to shore. The surrounding nutrient-rich cold waters rise from the deep to meet mineral-rich streams flowing down from coastal mountains. Together, they nourish an extravagant diversity of living things.

The rising nutrients are the basis of a phenomenon called "upwelling." In much of the world's oceans, when marine plants and animals die and



Harbor seal at San Juan Island

decay they sink to the ocean floor. Their organic remains do little good, other than to slightly enrich the deep, abyssal sediments. But where upwelling occurs, these abyssal waters are drawn to the surface, carrying with them the nutrients which sustain an incredibly diverse shallow-water food chain.

Strong tidal currents and swift ocean streams disperse the nutrient-laden waters that support the prolific North Pacific subsea environment.

Unfortunately, the very forces that help nourish this wealth of diverse and beautiful marine species challenge the skills of divers. Scuba diving in the current-swept areas is limited to a slack-water interval occurring twice a day. This window of opportunity opens when the tidal current is at its weakest point, as the tide changes direction. In the Northwest, consulting the tide and current tables becomes a ritual akin to drinking one's morning cup of coffee.

Though upwelling causes an explosion of life, it adversely affects underwater visibility. By late spring, upwelling, river runoff and increased sunshine bring on a synergistic binge of microscopic plankton reproduction commonly known as plankton bloom. Visibility can drop from winter levels, averaging 50 feet, to a dismal range of three to 10 feet within a matter of days. The best time to dive, therefore, is during the fall and winter months.

The last obstacle to enjoyable diving is the fact that our waters are cold—very cold. Average water temperatures of about 45 degrees Fahrenheit year-round make a quarter-inch wet suit less than adequate. Dry suits and "Ewok" undergarments are preferred among active Northwest divers.

The inevitable comparison of global dive locations social gatherings gives the Northwest divers the heavy ammo when the word *huge* is used to describe underwater animal life. In comparison to tropical species, most marine life forms here can be considered giant, benefitting as they do from the abundant nourishment of swift-moving water. The most powerful predators on earth, the Orca or killer whale is seen here year-round. Their intelligence and

cunning behavior continue to amaze scientists and others lucky enough to see them in their natural surroundings. The giant Pacific octopus, our much-maligned monster, can be found lurking in Puget Sound waters in world-record size. Individuals weighing 100 pounds with arm spans of 20 feet are not uncommon. *Octopus dofleini* is also highly intelligent. It is one of the only invertebrates to actually use strategy rather than instinct to capture prey. Another Northwest prize, the geoduck (pronounced "gooey-duck"), is the largest of the burrowing clams. This is the ugly bivalve on display at fish markets such as Seattle's famous Pike Street Market. The sight of a geoduck is bound to either fascinate or disgust passersby. The clams' shells measure up to 10 inches long, and their phallic-shaped necks can extend more than three feet. Northwest waters hold the largest, fastest and the greatest variety of starfish. Brilliantly colored in red, orange and purple, the giant sunflower star feeds on clams, sea cucumbers or even smaller sea stars. Giant barnacles the size of softballs wave their feathery feet to feed on passing phytoplankton, those magical, minute green particles that not only make this a world of giants, but also give the emerald sea its distinct hue.

Most diving in Washington occurs in three regions: Puget Sound, the Strait of Juan de Fuca and the San Juan Islands. The outer coast along the open Pacific Ocean is mostly inaccessible for diving, south of Cape Flattery. Long sandy beaches, heavy surf and little if any beach access prevent undersea exploration along the length of the outer coast.

Strait of Juan de Fuca

Cape Flattery, the northwesternmost point in the lower 48 states, is a fabulous vantagepoint. From here, you can see the entire entrance to Juan de Fuca Strait. Ranging from 12 to 16 miles wide, the strait separates Canada's Vancouver Island from the U.S. mainland. The beginning of a vast inland sea, this is the connecting channel between the Pacific Ocean and the interior waterways of Puget Sound.

Neah Bay is a small fishing village a few miles south of Cape Flattery. Famous for the trophy salmon caught nearby, the town is filled to capacity for brief intervals during the short, frenzied salmon season. The area's direct exposure to the Pacific Ocean makes the diving around Neah Bay seasonal, at best (when the fog finally lifts). On a rare calm day, divers can sample world-class dive sites guaranteed to boggle the mind.

Duncan Rock is a wave-battered ex-



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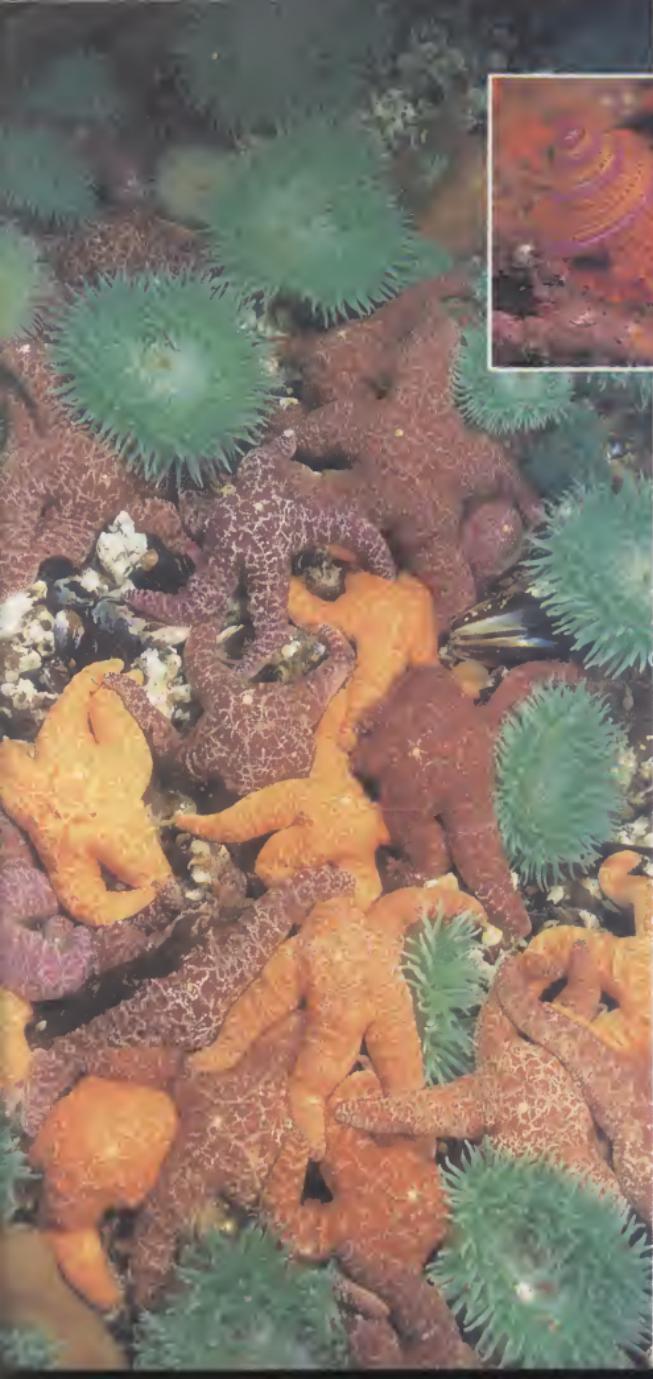
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Ring top snail, top,
is indigenous to
Pacific Northwest
waters. At left, are
pisaster starfish and
green anemones.
Diver caresses a wolf
eel at Sekiu.

posed pinnacle near Tatoosh Island. The ultimate status among Washington divers belongs to those who've made the most dives on this revered rock. Below the frothing surface lie breathtaking caves, arches and giant crevices. The competition for space among the invertebrates is a sight to behold. Rock scallops the size of dinner plates are covered with soft coral, which in turn supports algae and basket stars. It is impossible to touch bottom without disturbing encrusting sponges, tunicates, barnacles, nudibranchs and oodles of sea anemone growing on top of other living matter.

Tatoosh and Waddah islands provide a small windbreak for boat dives. Several campgrounds and inexpensive motels make this area ideal for a late-

summer excursion. Far West Resort has an air station, and handles dive charters on a limited basis.

Twenty-five miles east along a scenic, winding road lies the settlement called Sekiu. Another fishing village, it has several stores, huge campgrounds and cottage motels. Herb's Motel & Charters in Sekiu offers air fills only. Pinnacle Rock and One-Mile Beach afford nearby shore dives, and sturdy open fishing boats can be rented for diving around Sekiu's rocky coast. There are numerous dive sites in either direction, divisible only when the weather is calm. However, the rocky reef life disappears some 50 feet below the surface, giving

way to barren sand and gravel. Shallow dives here are marvelous when the surge and waves subside. Thirty-foot rock walls are lined with giant Tealia anemones, the size of serving platters. Dense schools of rockfish hover just out of reach, while wolf eels and octopi can be seen throughout the strait. Look for scattered remains of clam, crab and sea urchin shells outside a crevice.

Moving further away from the open ocean, Port Angeles and Port Townsend are diving locales worth exploring all year long. Salt Creek County Park, some 11 miles west of Port Angeles, makes an excellent base camp. Right below it is a great site for a shore dive.

(Please turn to page 72)



Orcas off San Juan Island

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Strait of Juan De Fuca

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Sekiu, WA 98381
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San Juan Islands
Snug Harbor Marina Resort
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Friday Harbor, WA 98250
(206) 378-4762
(Air fills, Boat Rental)

West Beach Resort
Route 1, Box 510
East Sound, WA 98245
(206) 376-2240
(Air fills, Boat Rental)

Puget Sound
Silent World
13600 NE 20th St.
Bellevue, WA 98005
(206) 747-8842

Northwest Divers
1113 River Road
Puyallup, WA 98371
(206) 845-5350

4815 North Pearl
Tacoma, WA 98466
(206) 753-3973

Bellingham Dive & Travel
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Bellingham, WA 98225
(206) 734-1770

Gary's Skin & Scuba Diving Center
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Longview, WA 98632
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Whidbey Island Dive Center
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Tacoma—Pierce County Visitors Bureau
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Port Townsend Chamber of Commerce
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(Please turn to page 72)



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—Ed Montague

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(Please turn to page 72)



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Better In The Long Run.



Tricia implies things, facts or matters of little importance. *Trivia Quiz* is about bits of ordinary, but not necessarily insignificant, knowledge about diving, the underwater environment and closely related subjects. It is hoped it will be both entertaining and informative, and I invite you to comment, and to share with other divers your trivia questions which must be submitted with answers. When submitting your trivia, enclose the answer you think is correct.

Each issue, about 20 Trivia questions are published to challenge your knowledge and stimulate your thinking. We're trying something new this month. Five of the 20 questions are based on material published in recent issues of *Scubapro Diving & Snorkeling*. The information may have appeared in an ad, in a photograph, in an editorial or in a feature article. We pause for 60 seconds while you review your back issues.

1. For thousands of years, man-made objects have been placed underwater for the purpose of increasing or attracting the population of marine organisms. For five quick and easy points, what is the popular name for such a collection of objects?

2. The maxim, "Time and tide wait for no man," is based on the inexorable fact that little can be done about either the passing of time or the fluctuations of the tides. For five points, tame the tides by answering these questions. First, the principal causes of tides are the gravitational forces of the giant sun and the much smaller moon. Which has the greater effect, the sun or the moon?

3. More about our restless sea. When the tide is rising it is said to be a _____.

4. A slack tide refers to which of the following?

- a. _____ The lowest point the tide reaches.
- b. _____ The highest point the tide reaches.
- c. _____ The time when there is no flow of tidal water.
- d. _____ When the moon is directly overhead.

5. The condition and actions of tides can affect diving safety. While planning a dive, what publication should a diver consult to determine tidal information in the area?

6. Five points and go to the head of the (photography) class if you can answer this one. There are two types of color film available for underwater photography. They are positive color film and negative color film. Which of the two is better for making color slides?

E.R. Cross is a pioneer in the field of diving. He has been associated with the sport for 55 years. Mr. Cross served as a U.S. Navy diver during World War II and the first two Bikini atomic bomb tests. He later operated the first commercial diving school and worked for Chevron in Hawaii until retiring in 1985.

7. Review your thinking about some of the sea's marine life. Don't get stung by this one. The float and long tendrils of a Portuguese man-of-war that has been washed up on the beach are no longer dangerous because the animal is dead.
True _____ False _____

8. The terms eagle, bat, butterfly, river, cow-nosed and devil have one thing in common. They are all _____.

9. All manta rays have stinging barbs on their tails.
True _____ False _____

10. For one point each, match the following classes of divers to the best description of the work each performs.

- | | |
|----------------------|---|
| 1. Commercial divers | a. Harvest products of the sea. |
| 2. Saturation divers | b. Construct harbors and dams. |
| 3. Military divers | c. Do instrumentation work and study marine life. |
| 4. Open sea divers | d. Work on offshore oil rigs. |
| 5. Research divers | e. Perform various duties in defense of the nation. |

11. Modern divers have become vagabonds and think nothing of traveling hundreds or thousands of miles to their favorite dive paradise. Part of one large U.S. island dependency was hit hard by hurricane Hugo but is now completely recovered and waiting to again welcome divers. For five points, what is the name of this island paradise?

12. A few years ago Sea Hunt was the TV program for divers to watch. For five points, what is the name of the lovely lady diver who did the diving for female stars of the series?

13. This is a switched Trivia repeat for old-timers or for those who remember the question from a few issues past. Sea Net Manufacturing Company, a dive equipment manufacturing outfit, went out of business because of the retirement of a true diving pioneer. What was this man's name?

14. While on the subject of interesting, diver-type personalities, and for some more points, who was head of the U.S. Navy ship salvage during most of WW II? (Note: He is not an author.)

15. While on the subject of ships and salvage, match the names of some famous vessels with their ultimate fates.

- | | |
|---------------------------|---|
| 1. The liner Normandie | a. Torpedoed in World War I, off Irish coast. |
| 2. The liner Titanic | b. Sunk in collision off New York. |
| 3. The liner Lusitania | c. Burned and capsized, New York. |
| 4. The liner Andrea Doria | d. Stranded, total loss, off Great Britain. |
| 5. Tanker Torrey Canyon | e. Sunk after collision with iceberg. |

SCUBAPRO Trivia Quiz

BY E.R. CROSS

Illustration by Tom A. Russell



16. This is a two-parter, 2½ points for each part. You won't know the exact answers, but see how close you can come—and be shocked at the correct answers! During the period from 1976 through 1980, there were quite a few vessels sunk due to various causes. (a) Choose the answer you think is closest to the total number of vessels lost in that five-year period.

1. 400 _____
2. 800 _____
3. 1,200 _____
4. 1,600 _____
5. 2,000 _____

(b) What is your best guess as to the total tonnage of the vessels lost? A clue: it's in millions of tons. _____

By the way, this figure represents less than a 2 percent loss of the total tonnage of vessels over 100 gross tons afloat at that time.

17. Nearly all artifacts salvaged from a submerged wreck deteriorate very rapidly if preservation measures are not taken immediately. For five points, after being washed thoroughly in fresh water, how long should steel, brass or bronze objects be soaked in renewed fresh water before further curative work is attempted? _____

18. For safe open-sea diving, knowledge of equipment and of necessary skills, as well as practice in those skills at all levels of difficulty is required. The best way to develop advanced diving skills is through training in an _____

19. This is a repeat from an ancient (two years old) Trivia Quiz. Most of these famous pioneer spearfishermen and gear-makers are still active. For five points, match the first with the last names of these great men of free diving.

- | | |
|------------|-----------------|
| 1. Jack | a. Potts |
| 2. Big Jim | b. Pinder |
| 3. Wally | c. Christiansen |
| 4. Art | d. Prodanovich |

20. Watch this one—it might grab you. If I told you I had been diving in the "100-foot hole" off Waikiki and had collected three slippers, one peppermint stick and three spinys, for your last chance for five points, (a) how deep had I been diving and (b) what animals did I collect? Get (b) correct and you win. You would not know (a) unless you, too, had been to this fabulous dive place. _____

These questions are designed to titillate, rather than satiate your interest in diving. They can also provide a low-key learning experience that may help you enjoy diving even more. Keep in mind, SCUBAPRO reserves the right to be wrong. If you think we are wrong, let us know. Also, take the time to join in the fun by submitting your own Trivia Quiz questions. If, allowing five points for each correct answer (without peaking at the answers on page 78), you scored:

- 0 to 25 - You'd better hedge all bets about diving lore.
26 to 50 - Not bad, but keep working on your dive data.
51 to 75 - Take the day off and go diving.
76 to 100 - Astounding! The genuine genius level.
Aloha. See you next issue.



THE WAY IT WAS

BY E.R. CROSS

The art of going underwater and remaining for a considerable time. That's what diving is all about. But there are tremendous variations within this simply defined activity called diving, in the time spent underwater, in the reasons for diving—sport, scientific or commercial; in the type of equipment used, and in many other aspects. "The Way It Was" researches, reviews, and comments on the broad range of all past diving events, be they technical, his-

torical, or side-splitting comicalities. Your comments, suggestions, photographs, or questions about the way it was in the yesteryears of diving are welcome. This is your column too. Address inquiries to Aqua-Field Publishing Co., 66 W. Gilbert Street, Shrewsbury, NJ 07702.

Taravana—The Killer of Pearl Divers

It had been three months since I had sighted the first of many palm-crowned, coral-ringed lagoons of the Tuamotu Archipelago. During those three months in the early fall of 1958 I had cruised these low-lying South Pacific atolls, studying the diving habits of the Paumotan pearl divers, probably the greatest breath-hold divers in the world. I'd watched them dive to depths as great as 130 feet, and sometimes more;

watched as they harvested pearl shell from the bottom of the many lagoons; and watched as some of them died from a disease they called Taravana.

Now it was early evening. I anchored my 60-foot schooner *Four Winds* close off the village of Tupapati on the lee shore of Hikueru Lagoon, the richest and deadliest pearl lagoon in the South Pacific. Tomorrow I would spend the day diving with these great men of the sea.

The Tuamotu Archipelago extends 1,200 miles across the Pacific Ocean from approximately 135 to 149 degrees West Longitude. The islands are bounded on the north by the 15th parallel of South Latitude; on the south by the 23rd parallel. Makatea and Tikea islands are steep-sided, spectacularly rugged volcanic peaks jutting high out

of the water. The remaining 76 islands are bleached coral atolls, little more than palm-crowned ocean hills dotting the face of the South Pacific, with deep ocean passages between. They are known to sailors around the world as the Low or Dangerous Islands.

While much the same in structure, the islands vary greatly in size. Some are less than ten miles in diameter; others may be over 100 miles long. The tallest objects on these atolls are usually the palm trees, the tips of their fronds waving in the breeze at heights of up to 60 feet above sea level. The exception on some islets is the glistening white spire of the village church.

Winds blow almost constantly from the easterly quadrant with a force of ten to 13 knots, increasing in strength from May through August to 13 to 21 knots. Hurricanes are rare, but when they do occur they cause great damage to the pearl industry, creating waves that sometimes sweep completely over the low-lying islets. Air temperature ranges from 75° to 85° Fahrenheit. Water temperature in the lagoons is usually about 82°, dropping slightly in the open ocean outside the lagoons to about 79°. Water temperature varies but one degree to a depth of 20 fathoms.

Pearl shell is found in almost all the lagoons of the Tuamotu Archipelago, but only a few of the atolls now have shell in commercial size and quantity. In 1920, it was reported that there were 4,500 pearl divers working the pearl beds of the South Pacific, not all of them in the Tuamotus. Pearl shell, not pearls, is the commercial product harvested by the divers. Records indicate that in 1955, some 857 tons of pearl shell were harvested in the Tuamotus; in 1956, 488 tons, of which 252 tons—over half the total—came from Hikueru Lagoon. This lagoon is small—perhaps seven miles long by just over half that in width.

I got up early the next morning to get my diving gear ready for a day with the pearl divers. In the village I could see pareu-clad women moving about in the light of brightly burning dried palm fronds and coconut husks as they prepared breakfast for their men. To the east, a pale dawn began to lighten the scene and in the dim light along the shore I saw long, square-sterned outrigger canoes being readied for the coming day's work. Thin ropes tied to lead weights were coiled in the bottoms of the canoes. Woven rope baskets tied to heavier ropes were placed forward. Bamboo tankards filled with drinking water, meager lunches wrapped in green leaves, and some fruit were placed near the stern.

The divers were ready but paused for a moment to enjoy the quiet beauty of the dawn unique to South Pacific

Tahauri Huthihuti,
left, and his son
Turoa at Hikueru
Lagoon in 1958.



lagoons. The mesmerizing sound of the rustling palm fronds disturbed by trade winds and muted, mumbling surf incessantly babbling at the bleached-white coral reef created a peaceful atmosphere. Finally the sun came up but was partially hidden behind the coconut palms on the eastern islets. In contrast to this beautiful, lazy scene, the village of Tupapati on the western shore of the lagoon was awake and prepared for a day of pearl diving. Suddenly a rumble, sounding at first like distant thunder but steadily growing to a roar, rolled across the lagoon. Hundreds of outboard motors on the sterns of as many outriggers had exploded into life. The first day of the pearl diving season had begun for the divers and their helpers in the rich and deadly Hikueru Lagoon.

An hour passed as I waited on deck. Then a small canoe left the beach, an old man sitting proud and erect in its stern as he paddled through the reef by way of a small channel toward the *Four Winds*. The man was Tahauri Hutihihi, from the island of Takapota, a pearl-producing atoll northwest of Hikueru. Tahauri and the rest of the able-bodied divers from nearly all the lagoons came each year to Hikueru during the pearl diving season. He and his son Turoa, whom he would join in a large pearl diving canoe inside the lagoon, were to be my guides for this day among the pearl divers.

"Toarana," he shouted as he deftly brought the canoe alongside. "We go now," I replied with an English equivalent to his Paumotan greeting, handed him my gear and dropped into the bow of the small outrigger canoe. With a nod of his craggy head and a grin spread over his broad face, Tahauri handed me a paddle and turned the bow of the canoe toward the narrow pass leading into the lagoon.

In spite of his 71 years, this wise old man was still active in pearl diving. Tahauri and Turoa, father and son, had worked as a diving team for 31 years, since Turoa's 17th birthday. A month before, I had spent a week with them in Takapota Lagoon as they worked from a large pearl diving canoe. Tahauri used no diving equipment except a face mask, his one concession to "modern" diving. During one day of diving this old man made a total of 47 dives, to depths of 115 to 120 feet. Each dive lasted about two minutes, with an average of ten minutes' rest between dives. Forty seconds were used in descent, 60 seconds spent as bottom time gathering shell, and 25 seconds required for the ascent. If I had equaled this diving time using scuba, I would probably have used seven cylinders of air and would have needed long periods of decompression.



Pearl shell from Tuamotus awaiting shipment at Papeete, Tahiti.

We were soon inside the lagoon, where we joined Turoa in the large canoe. Hundreds of pearl diving canoes were scattered over the surface of the lagoon, some still plowing through the water at top speed. In one area, a large group of canoes were bunched together. Turoa started the outboard engine and headed our canoe toward this group. When we were near I could see the boats were anchored several yards apart. *Tetes* (helpers) lowered rope baskets into the water until the baskets hung three to four feet off the bottom. The ropes leading to the baskets were tied to cleats on the sides of the canoes. The divers pulled themselves back to the surface by means of these ropes. Smaller ropes with 12-pound weights on one end were coiled in the bottom of the canoes. These were used by the divers to take them rapidly to the bottom.

"Today, very bad," Turoa remarked. "Good weather. Much shell." Tahauri explained this apparent contradiction: "Much *nou nou parau*—Many accidents."

They didn't have to explain to me that *nou nou parau* means pearl-shell insanity. The divers working the rich bed of pearl shell under these ideal conditions go crazy with greed and continue to dive, taking almost no pause between dives, until the last shell is gone or until Taravana strikes.

The Paumotan pearl divers were skin divers. They used no breathing apparatus nor any but their natural air supply for their underwater work. Because of this, they felt they were in no danger of bends or of air embolism. Their principal fear was that Taravana would strike. Taravana, a pleasant-sounding name for a disease, was unknown to the medical profession at that time, but known to every man, woman and child of the remote

Tuamotu Archipelago.

Translated from the language of the Paumotans, Taravana means to fall (*tara*) crazily (*vana*). On this day in Hikueru Lagoon, of the 235 divers working 47 suffered Taravana. Thirty-four suffered vertigo, nausea and what they called "mental anguish." Six suffered partial or complete paralysis. Three fell unconscious but were rescued by their *tete*. Two were seriously affected mentally and two died.

I spent the rest of the day talking with the divers as they came back to Tupapati. It seemed the most likely cause of some Taravana symptoms was, at least in part, a lack of oxygen in the blood and tissue of the body. Since the divers hyperventilate between dives this could contribute to some symptoms due to hypoxia. This is particularly so since symptoms frequently affected the diver just at or just below the surface as he was returning to the canoe. I also believe that many of the more serious symptoms were the result of decompression sickness. Normally it would not seem probable that breath-holding diver could get bent. However, the depth, duration and frequency of the dives could provide enough bottom time versus surface interval that nitrogen uptake could become a serious problem. Without decompression, deep, frequent dives for shell could lead to a fatal attack of bends.

I wish I could say I was able to help the pearl divers in the Tuamotus, but I can't. Local governments were not receptive to suggestions about changing the way the divers worked. After all, they had been diving that way for over 100 years. And some had died each and every one of those years.

And that's the way it was in the tranquil South Pacific lagoon of Hikueru on that sad, fatal day in 1958.

\$



BY RICHARD E. EASTON, M.D. "

What? Otitis externa is a killer disease? You've got to be kidding!"

"No, I'm certainly not kidding."

"Well, since I listen to everything about diving with an ear to increasing safety and decreasing risk, why don't you explain how there is more to external otitis than they have been telling us?"

A Very Short Fairy Tale

Once upon a time in a land far away, there were people called Tailors who stitched custom-made suits for the gentlemen of the time. The curious thing about these Tailors was that no matter how recently a customer had been in to see them, even if only the day before, they would always take his measurements as though doing it for the first time.

The physicians of the time, taking cues from anyone of superior intellect, probing insight and wise perception, adopted the principle, too. They began to "take the measure of" diseases with which they thought they were familiar, reassessing longstanding knowledge in light of the day's new patients, new signs and new symptoms. Much to their

surprise, their studies reaffirmed two time-proven, but often forgotten principles:

1. Familiarity really does breed contempt—the physicians began reexamining common diseases, making new discoveries every day.

2. Chance favors the prepared mind; the more they studied the "same old diseases," the better prepared they were to detect variations in those problems, discern differences earlier and begin treatment more quickly, thereby often limiting the length and severity of an illness.

Only in recent years have these ancient principles resurfaced, but since they have, it will pay us to keep them in mind when looking at simple, external otitis and its sometimes fatal consequences.

How An Ear Pain Can Be Fatal

Moisture can wash away ear wax which, in proper amounts, provides a natural protective coating to the ear canal. If the protective coating is removed, bacteria which occur normally in the canal can burrow into its lining and proliferate. People whose ear canals are narrow, curved or obstructed are especially susceptible to infection.

Ear wax (in normal amounts) also provides protection against infection because it is mildly acidic. This is why ear drops contain alcohol and glycol as drying agents as well as boric or acetic acid.

Richard Easton, M.D. is a graduate of the University of Kansas Medical School and the Harvard University School of Public Health. He is presently collaborating with his wife Fran, a Doctor of Psychology on a book tentatively titled, Diving Secrets: Essential Keys to Diving Fun and Safety.

in the Morning

In a worst-case scenario, moisture breaks down the protection afforded by ear wax, bacteria gain entry to the skin of the ear canal, and human body temperature (98.6° Fahrenheit) helps provide an environment ideal for the growth, development and spread of our old, familiar enemy, external otitis.

As we examine this supposedly familiar enemy of divers (by reassessing reports of patients suffering from ear infection) we discover that two very important and very different kinds of external ear infection (otitis externa) have developed within recent years. The first is called acute otitis externa (AOE), which responds well to the short-term use of routine, familiar antibiotics. The second, malignant otitis externa (MOE), requires rapid institution of therapy employing longer-term, stronger antibiotics, whose names are often less familiar.

Acute Otitis Externa

A diver may incur AOE during a dive or after a short, latent phase of one to three days following cessation of diving. The infection is accompanied by a yellowish or white, watery to thick drainage or discharge from the affected ear. The severity of the inflammation is generally proportional to the amount of pain produced by gently holding the back edge (pinna) of the ear and moving it up and down.

The usual treatment for AOE includes cleansing the ear canal by irrigation, removing excess ear wax, products of infection or other debris in the canal and

instilling drops containing a combination of antibiotic and cortisone (Cortisporin Otic is commonly used), four times a day for seven to ten days. For those cases which do not respond to local treatment, an antibiotic such as amoxicillin (250 to 500 mg taken orally, three times per day) should be effective.

In the past few years, articles addressing the second kind of ear infection began to appear in medical literature, noting its more serious nature as well as its higher resistance to treatment. Divers should be aware of MOE, and of its dangers. The name malignant otitis externa says much about the severity of the infection.

Malignant Otitis Externa

MOE is an invasive, tissue- and bone-destroying infection usually caused by a bacteria called *pseudomonas aeruginosa* (just call it Sue Doe Moanaz). It presents itself through chronic ear pain and drainage, but is unresponsive to familiar ear drops and oral antibiotics. In spite of treatment, the drainage worsens and the pain increases, spreading from the ear itself to the bone in front of and behind the ear. In the worst cases, the infection can involve the facial nerve (cranial nerve VII), causing a unilateral (one-sided) paralysis of the face, much like that which occurs in Bell's Palsy.

MOE characteristically attacks elderly or debilitated patients. Diabetics are in many cases particularly susceptible. When the drainage is grown (cultured) in the laboratory and tested, the *pseudomonas* (and the *staphylococcus*

aureus) bacteria which sometimes accompanies it) are both resistant to all the usual antibiotics. In addition, these organisms are resistant to the usual (Cortisporin) ear drops and must be attacked with six weeks or more of gentamycin (with or without azlocillin) therapy, involving the application of strong ear drops, four times per day. This forceful combination sometimes has to be combined further with metronidazole (Flagyl) to cover any anaerobic bacteria (those which grow without the need of oxygen) which also may be present in the infected ear.

The *pseudomonas* and *staphylococcus* "bugs" which wreak this havoc are totally unaffected by synthetic penicillins or cephalosporins. The drugs usually mentioned in articles on treatment of these "bad dudes" are either Fortaz (cefazidime) or Cipro (ciprofloxacin, 600 to 750 mg, twice a day) and rifampin (600 mg, twice a day), the latter two given for at least six to 12 weeks, during which time you will not even be thinking about diving! If these drugs fail, you go into the hospital for intravenously administered therapy.

So, if MOE is a disease of debilitated nursing home patients and diabetics, why am I telling you young, healthy divers about it? Because some of you may be diabetics, some may have hematologic problems and some may be taking medications which decrease your defenses to infection.

For the rest of us, when Murphy wrote his Laws and Corollaries he was sending us a message we should remember: if something can go wrong, it will. If little old ladies can get external ear infections, and if those simple, disgusting little external ear infections for which we have such familiar contempt can turn ugly, then some day they will. They might do it in your ear or mine, wrecking our hearing and our diving all in one "swell foop"—not too swell, and a big pile of foop.

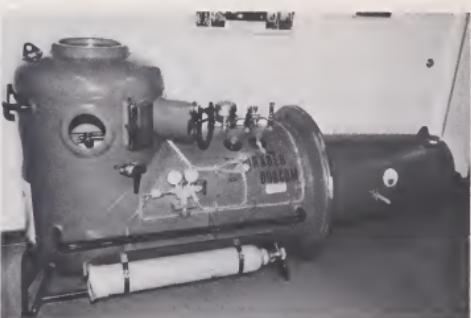
By exercising our contempt for the familiar we have unearthed an awareness of a new and dangerous variation of a simple disease, external otitis. That gives us the opportunity in the future to utilize the second ancient concept: *chance favors the prepared mind*. You are now one of those divers who knows that Murphy was right—that things can go wrong everywhere, even in medicine. Simple external otitis can turn into a killer disease. But now when it does, you will recognize that it has (AOE has changed to MOE), and can take the rapid therapeutic action required. You won't delay. Instead, you'll get the non-responding ear infection re-diagnosed and re-treated, and in the process save your ability to hear and dive in the future.

TABLES

(Continued from page 19)

compartments control shallower, longer exposures. Originally, there were five compartments of five, 10, 20, 40, and 75 minutes. Each had its own critical pressure (M-value), the maximum limit of dissolved gas. In the U.S. Navy Tables, 80 replaced 75-minute tissue, and a 120-minute compartment was added to accommodate deeper dives. Today's computers utilize compartments up to 720 minutes. This proliferation of compartments is a clue that we don't fully understand what is going on.

Over years of use, gaps appeared in the tables, unexplainable by dissolved gas theory. On certain exposures, there were greater incidences of bends. The tables would then be revised to cover those circumstances, even when the revision didn't agree with Haldane's original calculations. Wienke and his cohorts aren't comfortable with this patchwork approach. Their goal was to develop an algorithm (mathematical model) that was consistent with theory across the diving spectrum, including bounce, multilevel, repetitive, and multi-day diving. This model is intended to predict safe diving protocols for all depths and all sorts of diving, without



A two-man recompression chamber used to transport a bends patient and an attendant.

having to resort to quick fixes and fudge factors. It will be a model you can trust your body to.

Bubble mechanics begins with the concept that our tissues store persistent gas micronuclei. These have been demonstrated experimentally in gels, agar, salmon, and shrimp. Micronuclei are bubble seeds, about a micron in diameter. For comparison, red blood cells measure three microns. A Doppler meter cannot detect "silent bubbles" (non-symptomatic bubbles) less than 20 to 30 microns across. How did these micronuclei originate? The process is not entirely understood. Possible causes include gas in our intestines or in the fluids we drink, gas from the air-lung interface, exercise, and the mechanics of blood coursing through our vessels, among others. Even cosmic radiation and charged particles are suspected causes.

Micronuclei are stable at fixed pressure, but can become unstable when exposed to pressure changes. They are classified in families, according to their size and the characteristics of their surface-activated molecules (surfactants). Larger families are more excitable, that is, they develop and grow into bubbles more readily.

As pressure decreases on ascent, the micronuclei are surrounded by dissolved gases at high tension (pressure). When tissues around a bubble site are at a higher pressure than the bubble, gases diffuse from the tissue into the bubble. This increases internal pressure, making it unstable, and causing it to grow. The rate at which bubbles grow depends directly on the difference between tissue tension and ambient pressure. At some point, a critical volume of bubbles is established, and symptoms of bends can begin. This point can be calculated and correlated with data.

During compression (descent) on the other hand, the micronuclei are crushed to smaller sizes and apparently stabilize

at their new reduced size. This is one of the fundamental differences between free-phase and dissolved-phase dynamics. The gradients for free-phase elimination increase with depth, directly opposite to dissolved-phase gradients, which decrease with depth. Essentially, Haldanean procedures "treat" bubbles, while free-phase dynamics minimize bubbles.

This leads to one of Wienke's more interesting recommendations: make the first dive of a multi-day series a deep one. He explains that this procedure effectively shrinks and stabilizes micronuclei, allowing the diver to remain relatively clean for longer periods of time. This recommendation is tempered with the warning that all subsequent dives should be shallower, thus working within the micronuclei crush limits of the first dive, and minimizing excitation of smaller micronuclei. Frequent dives, at least every other day, deplete the number of micronuclei available to form potential bubbles. It takes about a week for some classes of micronuclei to regenerate. This is one way the body adapts to repetitive diving.

A word of caution is in order at this point. Short, deep dives will crush micronuclei, but longer exposures, or cumulative deep exposures will saturate the system with regenerated bubbles, exceeding the body's ability to eliminate them. How long is too long? A table based on free-phase dynamics would provide the answer.

Wienke cites two groups of divers who never heard of free-phase dynamics or the research behind it, but who have developed amazing procedures that fit this theory. In northern Australia, Okinawan pearl divers regularly dive to depths of 300 feet for up to an hour, twice a day, six days a week, 10 months out of the year. Their decompression schedules, developed through economic necessity rather than science, involve deeper but shorter

(Please turn to page 78)

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BY ERIC HANAUER

Nearly everybody loves manatees. They're homely to the point of being cute. They are also among the few marine mammals we can really get to know in the water. Most marine mammal encounters are fleeting, at the animal's prerogative, with the diver seldom allowed to get close. Not so with manatees. The right animal in the right situation will allow close observation, as well as touching and even hugging. No wonder divers and snorkelers enjoy the warm fuzzies with them.

But some boaters don't love them. Manatees interfere with their right to run their high-powered vessels at top speed in Florida's inland waterways. Last year, 42 manatees were killed in the state by powerboats, and the number will increase in 1990 as it does every year. About 90 percent of all adult



MAN or MANATEE?

manatees carry scars from collisions with propellers.

Some fishermen don't love them either. The animals hang around the warm waters of power plant discharges, which also happen to be among the best offshore fishing sites. Despite the fact that manatees are strict vegetarians, some people think manatees scare the fish away. Under the Marine Mammal Protection Act, boats and fishermen aren't allowed to interfere with manatees' activities, so if manatees are resting in these sites, it's the fishermen who are supposed to move. But many of them don't, driving the animals away from the warm water they need for survival during cold winters.

This is why Bob Bonde wishes more people would get in and swim with manatees. Bob, a biologist with the U.S. Fish and Wildlife Service, has been working with these animals for several years. "Anyone who swims with manatees comes out of the water a better person," he states. That's because it's impossible to share a swim with them and not become more sympathetic to the plight of these endangered animals.

Not everyone agrees. Elitists complain there are too many snorkelers in such gathering places as Crystal River, Florida, and that the manatees become victims of too much love and affection. It's true that on a typical winter day there may be up to 300 divers in the water, each one seeking a manatee encounter. But if an animal doesn't want to meet a diver, it simply swims away. An area near the spring is roped off as a sanctuary, where no boat or person is allowed to enter. Reluctant manatees know this area to be a safe haven, taking advantage of it when they don't want human companionship.

But many manatees interact freely with humans. They allow people to come close, and seem to enjoy the encounters as much as the divers. At the very least, they don't seem perturbed. The joy of such a meeting isn't limited to serious divers. Since manatees prefer shallow water, even beginning snorkelers can interact with them, often in water 10 feet deep or even less.

Still, there is an occasional surprise. On one dive I came across an apparition in full scuba gear, including a

For the manatee to cut its losses, more people will have to become more concerned about its future.



Snorkelers easily approach manatees who also seem to enjoy the encounters.

decompression computer. Either this diver was extremely insecure, or he was taking the Boy Scout motto too literally. On any other shoot, I would have been annoyed by a seagoing klutz's moving into my picture and possibly scaring off the animal. But at Crystal River, there were plenty of manatees to go around. Besides, in the presence of such gentle animals, it seemed inappropriate to let my aggressive human emotions take over.

West Indian manatees (the species found in Florida) belong to the order *Sirenia*, or sea cows, which also includes the Indo-Pacific dugong, the East African manatee, the Amazonian manatee, and the extinct Steller's Sea Cow. Essentially, manatees are found in the Atlantic, while dugongs live in the Pacific. Tradition suggests that Sirenians were the origin of mermaid legends, but any marinier confusing one of these half-ton beasts with the Little Mermaid has either been at sea too long or is sneaking extra hits from the ship's grog ration. Cows are a more apt comparison, because these slow-moving animals share the bovine bulk and seemingly placid disposition of cattle.

Their closest relatives in the animal kingdom are elephants and hyraxes. Manatee skin is like that of an elephant, about an inch thick, with a layer of subcutaneous fat (not blubber) underneath. They even have fingernails on their front flippers, resembling those of elephants. Normal lifespan is estimated at about 50 years in the wild; one specimen has lived over 40 years in captivity. Adults average about 10 feet in length and 1,200 pounds in weight, although they have been known to grow as large as 13 feet, and to tip the scales at 3,500 pounds. A female is sexually mature at five years. Copulation is a group grope, with many males taking part. Afterward, the female is left alone to a 12-month

pregnancy, usually resulting in a single calf.

Babies weigh about 80 pounds at birth, and are suckled by the mother for two years. Because her teat is located underneath her flipper, a nursing calf seems to be drawing nourishment from the mother's armpit. Most calves are infected by a harmless skin disease called fungal mycosis, resulting in a crinkly appearance of the skin. It doesn't seem to bother them, and most outgrow it by the time they are weaned. Three years after giving birth, the female is ready to bear young again. Their low birth rate is another factor that places manatees in jeopardy.

The usual concept of the gentle giant, meandering aimlessly through aquatic vegetation, is disputed by Fish and Wildlife researcher Sharon Tyson. Radio and satellite tracking reveal that migrating manatees can travel up to 60 miles in 24 hours. Originally limited to the Caribbean, manatees began moving north during the early 20th century, when power plants began operating along Florida's coast. The plants' warm water effluents lured these normally tropical animals northward. They used the plants as stepping stones to extend their range as far north as Georgia, in the summer.

Strict vegetarians, manatees eat aquatic plants including mangroves and hydrilla, a freshwater weed. As southern Florida became more developed and food sources there dwindled, manatees continued to migrate farther north. A problem developed when some of the older power plants began to periodically shut down. At such times, they no longer provided refuge from cold water, and manatees began to die from hypothermia during severe winters. The winter of 1989 was especially frigid, and over 50 manatees succumbed. Since their

total population had been estimated at 1,200, this 100-year record cold, combined with the ever-rising toll taken by power boats, was a serious blow.

Tracking manatees by radio and by satellite has taught researchers a lot about the species. A transmitter is attached to a six-foot tether, belted around the animal's tail. Attaching the paraphernalia is quite simple. A freediving biologist merely sneaks up behind a manatee and straps it around the tail peduncle. The device doesn't interfere with swimming—in fact, it may even be an asset. No tagged animal has ever been killed by a boat, probably because the floating instrument makes the animal more visible. Concerned boaters, however, occasionally report sightings of animals they think have become tangled in a line. Some have attempted to remove the transmitters.

VHF tracking is done by means of a receiver mounted in a truck. The researcher follows the radio signal, homing in on the animal and observing it from shore. At the present time, eight animals carry satellite tags, and about 40 more are monitored via VHF. The transmitters, which cost about \$4,000 each, are bought through donations from power companies and from the Kennedy Space Center.

Manatees have personalities of their own, so researchers sometimes have difficulty maintaining scientific detachment. They anthropomorphize the animals, giving them names like Hillary, Brutus, Flash, and Wonder Woman. In all, some 800 of the state's 1,200 manatees have been indentified, primarily by their propeller scars.

Essentially solitary animals, manatees' only regular social group consists of mother and calf. When the two meet, they often nuzzle each other, as though kissing. Sexual activity is not very well defined. Recently a dive magazine published a photo purported to be the first ever taken of manatees mating. Bob Bonde revealed with a smile that all the animals in the picture were males.

Feeding occurs during day or night. Many animals take up nocturnal habits, possibly because there is less boat activity at night. They ingest 10 to 15 percent of their body weight in aquatic plants every day.

As more people swim with them, manatees have become more tolerant of humans. Both Bonde and Tyson point out that manatees are careful never to hurt people. Sharon described an encounter. She was treading water, with a manatee behind her. Another one in front suddenly charged, but veered and rolled over at the last second. Its skin was covered with barnacles. Had it made contact, Sharon could have been severely cut. At Crystal River, I had a

similar experience. Calves are naturally curious, and love to be scratched and rubbed. While playing with a calf, I suddenly felt a push in my back. The mother had just let me know she was there, then gently rolled over. Had she wanted to, she could easily have squashed me.

These intelligent animals have even figured out how to use the locks in Florida's inland waterways, seeming to enjoy riding the waves when the gates open. One of the lockmasters keeps track of manatees, and waits patiently for individuals to lock back through, even if it means working overtime.

This spirit of volunteerism and caring among the public is evident throughout Florida. The state government has stood solidly behind the manatees, sponsoring research, setting aside sanctuaries, and establishing speed zones. This has happened despite lobbying by the boating industry. At last count, there were 800,000 boats in Florida, outnumbering the manatees by more than 600 to one.

Since manatees congregate in warm freshwater areas during cold winters, that is the best time to see them, and Crystal River is the best place to do it. Numbering about 280 animals, the Crystal River population moves in from the Gulf of Mexico around December to bask in 72-degree water. At sea, manatees get necessary water through their diet, but freshwater outlets of any kind are always a treat. Additionally, the freshwater kills and removes barnacles that have become attached to their skin during the manatees' ocean journeys.

The town of Crystal River is a booming resort. At one area along the main street, I counted four dive stores within two blocks. Tourists, therefore, have no problems finding a way to get wet. Leave your scuba gear at home, because owing to the shallow water, this is strictly a skin diving experience. The water is warm enough and your activity level will be high enough to maintain comfort in a tropical 1/8-inch wetsuit.

Crystal River isn't a river as we know it, because it has no current. It's more like a shallow lake. Its uneven shoreline is rimmed with lush vegetation and surrounded by resorts and private homes. A boat is helpful, but not necessary, because manatees are spread throughout the area. Although we were fortunate enough to be riding a Fish and Wildlife vessel, we spotted divers working out of everything from inflatables to canoes, some even swimming out from shore. There were plenty of manatees for everybody.

A strict five mph speed limit is enforced in Crystal River. Even at that speed, manatees are sometimes difficult to spot. Bonde stopped the boat well

short of an animal, then gently lowered the anchor into the water. We slipped in and kicked over to the spot where we'd last seen it, but the manatee was gone. This experience was typical of our first few attempts, but it gave us a chance to look around the sand bottom. On one of these dives, my wife Mia yelled that she had seen a six-foot tarpon. She rarely exaggerates, but for some reason I drew a blank and wasn't impressed. Suddenly I spotted a huge silvery fish, bigger than I was. Bonde explained that saltwater fish like tarpon and jacks occasionally migrate into Crystal River, and can comfortably handle fresh water for short lengths of time.

I never even saw the first manatee I met. Visibility was so poor that I touched it, hugged it, and even climbed on its back without seeing it. We had been trying to avoid the other divers, but finally moved near them, since they had located a group of manatees.

Visibility was about 20 feet on the sandy bottom broken by patches of aquatic weeds. Whenever we saw muddy water, we followed the dirt trail, which in many cases led to a manatee. We observed several behaviors, including feeding, nursing, and sleeping. Manatees take short catnaps with their snouts buried in the mud, remaining in place for several minutes. They surface for a quick breath, then settle back down for another wince or two. We could hear them chewing, heads buried in vegetation, oblivious to divers. Every animal we saw bore scars from boat propellers. Some had been mutilated, bearing large notches in their tails.

They were so irresistible, we couldn't help but reach out and touch them. Most didn't seem to mind, letting as many as half a dozen divers hang around. None of the divers became too aggressive; they just enjoyed the experience and allowed others to do the same.

Our swim with the manatees was delightful, not only for what we saw, but also for what we felt: a kinship with and caring for these endangered animals. For a few moments, we were able to put aside the rat race and mellow out with these placid, peaceful creatures. Bob Bonde is right. You can't swim with them and not care. If the manatees die out, we will all be poorer for it.

Sale the Manatee Club is a private, nonprofit organization that promotes awareness and funds for both research and conservation projects. Singer Jimmy Buffet is the organization's chairman. Money is raised by allowing people to "adopt" one of 24 manatees at Blue Spring State Park. For their donation, "parents" receive a photo and biography

of their animal, five annual issues of the club newsletters, and invitations to special club events. At last count, there were over 11,000 members. For more information on joining, write Save the Manatee Club, 500 N. Maitland Ave., Maitland, FL 32751.

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Hooked on **MANATEES**

BY GEORGE P. SHARRARD

Half of catching fish is knowing where they are. The other half is knowing what bait to use. Thousands of pages are written every year on where the fish are running and what they will bite on. But, for all the articles on manatees telling you where they are, none say what bait to use. Well, let me set the record straight. I know what it takes to be a successful manatee fisherman.

Even though everybody knows where manatees can be found, there are still a number of people who never catch their limit. If you watch these people, it is obvious why they don't—their bait and technique are all wrong.

Many attempt the all too difficult "hand held" bait method. They enter the water holding a head of iceberg lettuce. When they sight a manatee, they begin to wave the lettuce. Getting no response, these "fishermen" become frantic and perform massive gyrations of waving lettuce and swimming for all they are worth toward the vanishing manatee. Needless to say, the hand held bait method is not productive.

Another often attempted technique is the rowing boat method. Here the fishermen never get in the water. Instead, they stand up in their boat looking for the ever elusive "mass schooling" phenomenon. Sure that they will miss a really big gathering if they get in the water, these fishermen are doomed only to see an occasional snout. (These are the same fishermen who after a beer or two begin telling everyone about the 20 manatees they saw while everyone else was underwater. It is best not to debate the point with them as no matter how many pictures you show them, they saw more and bigger manatees while everyone else was underwater.)

So what does work? Simple, all you need is a heavy nylon rope and a Danforth anchor! Here is how it works. Slowly motor your boat to one of the spots where manatees are known to gather. Don't bother with

baiting the water with food as manatees don't really like iceberg lettuce and they can get all the water weeds they want without your help. Anchor your boat using a Danforth style anchor. (Cement block anchors do not work nearly as well.) Enter the water and watch the anchor line carefully. Before you know it, the scent of the Danforth anchor will have lured in a manatee.

Here's where a fisherman's skills come in handy. You have to play the manatee just like a trout. Don't be too eager, let the manatee find the bait for itself. First they tease the nylon line—often times grasping it firmly in their mouth and performing a roll. All the time they are doing this they have their eye on the Danforth anchor—watching and waiting for the right moment to strike. It happens with the speed that makes the expression "Fast as a Manatee" understandable. Moving from the anchor line to the ring, to the shank, to the flukes—NOW!—you've got him. Simply snorkel down the anchor line and commence scratching to your heart's content. The manatee will remain as long as you're gentle with it and keep the anchor in sight.

Ah, the thrill of the hunt and the sweet taste of victory over one of nature's most clever creatures. Makes me proud to say, I'm a manatee fisherman.

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George Sharrard is the director of marketing for a New York company. This is his first contribution to SCUBAPRO Diving & Snorkeling.

NEW JERSEY

(Continued from page 39)

in the rocky jetties of the inlets. Bugs are easiest to catch in the early part of the season, before the sheer number of divers reduces the inlet population. Shipwrecks close to the shoreline, like the *Pliny* and the *Western World*, are ideal for artifact hunters. The visibility on these beachfront wrecks is usually very low, but there are periods in the summer when the visibility improves. During these times, a few fortunate divers view shipwrecks most divers will never see. There are two ways to find out about the best beach diving sites. The first is through local dive shops, many of which check out their divers in the inlets and off the beaches. The second is through local dive clubs. A listing of these can be obtained by writing the New Jersey Council of Diving Clubs, 414 Green Grove Road, Neptune, New Jersey 07753.

When talk turns to boat diving in New Jersey, the prime lure is the shipwreck. There are said to be more than 2,000 shipwrecks off the coast, some of which have been identified, many of which never will be. "Shipwreck Diver" is a general term that actually applies to many different disciplines. There are, of course, the hard-core wreck divers willing to spend long periods of time searching for the shipwreck of their dreams. Others fall into various categories: sightseer, artifact hunter, lobster hunter, spearfisherman, mussel and scallop hunter, and the category with the smallest following, underwater photographer. I'll address the last group first, as it is my favorite.

Many divers who photograph in the Caribbean will not do so in northern waters much closer to home. They feel they cannot obtain quality images because of the poor visibility and the particulate matter suspended in the water. Land photographers, in my opinion, surpass underwater photographers not only in equipment but in technique. A land photographer uses his or her ingenuity to overcome stumbling blocks, while many underwater photographers do not. Underwater photographers have tunnel vision when it comes to their art. If a situation is outside the tunnel, it is scrubbed rather than seen as a challenge to be met. A reason for this may be a lack of adequate instruction in dealing with local conditions. There is a tremendous variety of marine life in the waters off New Jersey and all of the Northeast. Much of it can be photographed using a macro or close-up system with the subject merely inches from the lens. Even in the lowest visibility, a macro image can be made. When visibility is 10 feet or more, the results can be

beautiful. In my six years of diving off the New Jersey coast, it has been gratifying to see the number of underwater photographers grow.

Lobster diving is always popular with the offshore crowd. On occasion (on more occasions than I like to admit) lobster hunting interferes drastically with my photographic pursuits. There is something addictive about the jolt of adrenalin one receives when hunting

and further cleaning the mussels. This should only be done when the boat is traveling at a slow speed.

The second popular type of seafood is the sea scallop. They are usually found in the sand in water deeper than 80 feet. Collecting them is simple: pick them off the bottom and put them in a mesh bag. Send the bag to the surface with a lift bag. Divers must realize that the extra weight of a catch of scallops



Sculpins are common to depths of about 90 feet.

lobster. Catching them is not easy. It cannot legally be done with a spear—it must be done by hand. The diver plunges his hand blindly into a hole, that may hold a lobster, trying to grab and extract it before the lobster's claws can do damage. This is the only technique that consistently works. To lobster addicts, the thrill of success outweighs the pain of the bite.

Looking at the different aspects of shipwreck diving, artifact hunting ranks at the top. I know divers who spend an entire dive fanning in the sand, hoping to uncover a bit of lost treasure. Although a shipwreck may have been on the bottom for hundreds of years, the unexpected often occurs. A prime example occurred last summer when New Jersey diver Bill Davis recovered the ship's bell from the wreck of the *Delaware*. The *Delaware* sank in 1898 and is one of the most dived artifact wrecks along the East Coast. Many veteran artifact divers were stunned by the bell's recovery. Bill had it professionally cleaned and it looks as good as the day it was cast.

There are three favorite types of seafood hunted or collected by divers. The easiest to harvest is the blue mussel, the same critter served in restaurants all along the coast. The only difficult part of harvesting mussels is finding a wreck that has them. Once discovered, a diver simply tears off clumps of mussels, puts them into a mesh bag and sends them to the surface via a lift bag. Aboard the boat, the diver picks off as much debris from the mussels as possible. The bag can be tied to a line and dragged behind the boat on the way back to the dock, tumbling

or mussels will make their ascent more difficult, hence the lift bag. Cleaning the scallop is easy. A fillet knife is run down the center of the shell, splitting the scallop meat in two. The shell is opened and everything but the white abductor muscle is discarded. After the unwanted portion of the scallop is removed, the scallop meat is trimmed for each shell with the fillet knife.

Fish are the third type of seafood available to the diver and can be legally speared in New Jersey waters. There are different types of spears available: hand, slings and guns. Some species of fish are much easier to spear than others. Bottom-dwellers like the fluke and flounder are the easiest. Spearing ling is more difficult than the flatfish, but they are much easier than seabass or blackfish. Although I do not spearfish, those who do express feeling the same flow of adrenalin I experience while hunting lobsters.

The most popular underwater activity in New Jersey is simply watching what goes by. The nutrient-filled waters off the coast provide abundant food supplies for a great variety of marine life. On the wrecks, fish seen include: seabass, blackfish, bergalls, ling, cod, pollock, monkfish, ocean pouts and occasionally, yellowfin tuna, bluefish, and sea turtles. The wrecks themselves are home for lobsters, sea anemones, hydroids and blue mussels. In the sandy areas around the wrecks can be found various species of crabs, sand dollars, fluke and flounder, plus an assortment of shell animals like the moon snail and scallop. There are days in the late summer when seas are so calm that the ocean sunfish can be found. These gen-

tle behemoths bask on the surface and offer an unforgettable experience for divers who swim with them.

Also in late summer, the mid-water area is filled with a multitude of life. Salps, also called eggs casings, are seen in an assortment of sizes and shapes. There are various species of jellyfish including the largest species in the Northeast, the lion's mane jellyfish. If divers take the time to look closely, they can see tiny butterfish, safe from predators, swimming amongst its tentacles. A diver may even be lucky enough to see the North American seahorse drifting in the current. Special experiences like these make diving along the New Jersey coast a real joy.

It would be misleading to say the visibility along the New Jersey coast is always great—it is not. The key to enjoying a dive, even when the visibility is bad, is to be able to refocus and adapt to the conditions. I have reached the bottom carrying a camera fitted with a wide-angle lens only to find the visibility to be between two and three feet. It is impossible to use a wide-angle lens in these conditions, so I spent my entire dive closely observing the marine life and I had a wonderful time. Having the right mental attitude and being able to tailor your dive to the conditions increases the enjoyment of any dive.

The best time to dive off the New Jersey coast is from July to the end of October. Bottom temperatures in the inlets are usually in the middle to high 60s. Offshore temperatures range from the middle 50s to middle 60s. A 1/4-inch wetsuit is necessary for comfortable diving.

Not everyone can or will become a New Jersey diver, and that is fine. The conditions here are more difficult than in the Caribbean, but many of us are willing to endure a little difficulty to spend more time at a sport we thoroughly enjoy. If you intend to dive in New Jersey, it is important that you understand the basics of inlet, beach and shipwreck diving. Details can be had at local dive stores or through local dive clubs. On your first inlet or boat dive, don't feel foolish for asking those around you for some insight. After all, as members of the diving community we must all look out for one another.

Commercial dive boats sail from all of the major inlets including Manasquan, Shark River, Barnegat, Beach Haven, Atlantic City and those farther south right to Cape May. A boat dive averages \$50. No license is presently required for spearfishing or shellfish gathering. Certain regulations apply to harvesting lobsters. Check with local dive shops or the N.J. Division of Fish, Game and Wildlife.

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Friday & Saturday: 10 to 6

Tucson School of Diving
3575 E. Speedway
Tucson 85716
(602) 795-1440
Tuesday-Saturday: 10 to 7

Water Sports Centers Inc.
1000 McCulloch
Lake Havasu City 85403
(602) 855-2141

ARKANSAS

Rick's Pro Dive 'N Ski Shop Inc.
2323 N. Poplar
N. Little Rock 72114
(501) 753-6004
Monday-Friday: 10 to 8
Saturday: 10 to 6

SportsCo-Scuba Hut
2007 W. Sunset
Springdale 72764
(501) 751-0638
Monday-Saturday: 9 to 6

CALIFORNIA

American Diving
1901 Pacific Coast Hwy.
Lomita 90717
(213) 395-5653
Daily: 10 to 7

Aqua Adventures Unlimited
2150 West Magnolia
Burbank 91506
(818) 848-2163
Monday-Friday: 10 to 7:30
Saturday: 10 to 5

Aqua Ventures
2172 Pickwick Dr.
Camarillo 93010
(805) 484-1594
Monday-Friday: 10:30 to 6
Saturday: 9:30 to 7

Aquarius Dive Shop

2240 Del Monte Ave.
Montgomery 93940
(408) 375-1933
Monday-Friday: 9 to 6
Sat. & Sun.: 7 to 6
For Guided Tours of Monterey
Call: 1-800-833-9992

Aquarius Dive Shop

#32 Cannery Row, Unit #4
Monterey 93940
(408) 375-6605
Mon., Wed., Fri.: 9 to 6
Sat. & Sun.: 7 to 6
Closed Tuesday

Aquatic Center

4535 West Coast Highway
Newport Beach 92660

(714) 650-5440

Monday-Thursday: 9 to 6
Friday: 9 to 7
Saturday & Sunday: 8 to 6

Big City Scuba

1720 North El Camino Real
San Clemente 92672

(714) 498-0069

Monday-Thursday: 10 to 6
Friday: 10 to 7
Saturday: 6 to 2

Bob's Dive Shop

4074 N. Highway 101
Fresno 93726

(209) 225-DIVE

Monday-Friday: 11 to 7

Saturday: 10 to 7

Sunday (Summer): 9 to 6

Cal Aquatics/Scuba Luv

22725 Ventura Blvd.

Woodland Hills 91364

(818) 346-4799

Hours: 10 to 6

Cal Scuba Center of Diving

1750 6th St., Suite 100

Berkeley 94710

(415) 524-3248

Monday-Friday: 10 to 6

Saturday: 9 to 1

Catalina Divers Supply

On The Pier

Avalon 90704

(213) 510-0330

Catalina Scuba, Inc.

P.O. Box 2362/314½ Metropole Ave.

Orange 90704

(800) 677-2822

Daily: 9 to 6

Colorado Dive & Supply

200 E. 8th St.

Needles 92363

(714) 326-3232

D.D.B. Dive Shop

PO Box 5429

Rancho Dominguez 90221

Monday-Friday: 10 to 9

Depth Perceptions

Diving Services

1325 #3 2nd St.

Los Osos 93402

(805) 528-1070

Monday-Friday: 6 to 11 p.m.

Sat. & Sun.: 9 to 6

Dive West

115 W. Main St.

Santa Maria 93454

(805) 925-5878

Monday-Saturday: 10 to 6

Sunday: 12 to 6

Divers Corner

12045 Paramount Blvd.

Downey 90242

(213) 869-7702

Mon., Wed., Fri., Sat.: 9 to 6

Tuesday: 9 to 9

Sunday: 12 to 5

Divers Supply of Santa Barbara County

5822 Hollister Ave.

Golleta 93117

(805) 964-0180

Monday-Friday: 10 to 6

Saturday: 10 to 5:30

Divers West

2333 E. Foothill Blvd.
Pasadena 91107

(818) 796-4287

Tuesday-Friday: 10 to 7

Saturday: 9 to 6

The Diving Locker

1020 Grant Ave.

San Diego 92109

(619) 272-1210

Monday-Friday: 9 to 7

Sat. & Sun.: 8 to 5

The Diving Locker

945 West Valley Pkwy., Suite L

Escondido 92025

(619) 746-5980

Monday-Friday: 10 to 7

Saturday: 9 to 6

The Diving Locker

405 N. Hwy. 101

Solana Beach 92075

(619) 755-6822

Monday: 10 to 6

Tuesday-Friday: 9 to 6

Sat. & Sun.: 8 to 5

Far West Marine Center

2941 Willow Lane

Thousand Oaks 91361

(805) 492-5000

Monday-Friday: 9 to 6

Saturday: 9 to 5

Far West Marine Center

1733 Los Angeles Ave.

Sierra Valley 93065

(805) 522-3483 (DIVE)

Daily: 10 to 6

Gold Coast Scuba

955 E. Thompson Blvd.

Ventura 93001

(805) 652-0321

Daily: 10 to 6

Holiday Dive Shop

1426 Eureka Way

Redding 96001

(916) 241-5171

Monday-Saturday: 8 to 6

Innerspace Divers

1305 N. Chester

Bakersfield 93308

(805) 399-1425

Monday-Friday: 10 to 6

Saturday: 10 to 3

La Jolla Divers Supply

7520 La Jolla Blvd.

La Jolla 92037

(619) 459-2691

Monday-Friday: 9 to 6

Saturday: 8 to 6

Sunday: 8 to 5

Malibu Divers

21231 Pacific Coast Hwy.

Malibu 90265

(213) 456-3396

Monday-Friday: 10 to 6

Sat. & Sun.: 8 to 6

Marina Del Rey Divers

2539 Lincoln Blvd.

Marina Del Rey 90291

(213) 827-1131 CA only

1-800-227-9042 Others

Friday, Saturday: 10 to 7:30

Sunday: 10 to 4:00

Motherlode Skin Diving

2020 "H" St.

Santa Barbara 93145

(805) 964-5878

Monday-Saturday: 10 to 6

Sunday: 12 to 6

Divers Corner

12045 Paramount Blvd.

Downey 90242

(213) 869-7702

Mon., Wed., Fri., Sat.: 9 to 6

Tuesday: 9 to 9

Sunday: 12 to 5

Divers Supply of Santa Barbara County

5822 Hollister Ave.

Golleta 93117

(805) 964-0180

Monday-Friday: 10 to 6

Saturday: 10 to 5:30

Openwater Habitat

411 South Main St.

Orange 92668

(714) 744-8355

Monday-Friday: 11 to 8

Saturday: 9 to 6

Sunday: 10 to 4

Ottridger Dive Shop

2110 Winchester Blvd.

Campbell 95008

(408) 374-8411

Monday-Friday: 10 to 7

Saturday: 9 to 5:30

Pacific Coast Divers

3809 Plaza Drive, Suite 108

Oceanside 92056

(619) 726-7060

Daily: 10 to 7

Pacific Sporting Goods

1139 Main St., Suite 100

Long Beach 90803

(213) 434-1604

Monday-Thursday: 10 to 6:30

Friday: 10 to 7, Sat.: 9 to 6

Sunday: 9 to 5

Pacific Wilderness & Ocean Sports

1719 S. Pacific Ave.

San Pedro 90737

(213) 833-2422

Monday-Friday: 10 to 8:30

Saturday: 10 to 6:30

Sunday: 9 to 5

The Pinnacles Dive Shop

875 Grant Ave.

Novato 94947

(415) 897-9962

Monday-Friday: 10 to 7

Sat. & Sun.: 8 to 4

The Pinnacles Dive Center

2112 Armory Dr.

Santa Barbara 93101

(707) 542-3114

Monday-Friday: 10 to 7

Sat. & Sun.: 8 to 4

Reef Seekers Dive Company

8642 Wilshire Blvd.

Beverly Hills 90201

(213) 652-4990

Monday-Friday: 10 to 7

Saturday: 10 to 6

Sunday: 12 to 5

San Diego Divers Supply

4004 Sport Arena Blvd.

San Diego 92110

(619) 224-3439

Monday-Thursday: 9 to 7

Friday: 9 to 9

Sat. & Sun.: 8 to 6

Sunday: 12 to 5

Scuba Cal USA

15 Tamarind St.

Vallejo 94590

(707) 642-9320

Monday-Friday: 10 to 6

Saturday: 10 to 4

Sunday: 12 to 6

Closed Sundays

Scuba Duba Dive Shop

7126 Reseda Blvd.

Reseda 91335

(818) 881-4545

Monday-Friday: 10 to 7

Saturday: 10 to 6

Sunday: 12 to 5

Scuba Toys

9547 Valley View Ave.

Cypress 90630

(714) 527-0430

Monday-Thursday: 10 to 7

Friday: 10 to 9

Sat.: 10 to 7, Sun.: 10 to 6

Sunday: 12 to 6

Scubaventures

2222 E. Cliff Dr.

Santa Cruz 95062

(408) 478-5201

Monday-Friday: 9 to 5

Saturday: 10 to 6

Sunday: 10 to 5

Sea to Sea

965 S. MI. Vernon Ave., Suite D

Colton 92324

(714) 825-2502

Monday-Friday: 10 to 7

Saturday: 9 to 5

Closed Sunday

Ski & Sports

1002 E. Knott Ave.

Orange 92687

(714) 633-1880

Monday-Friday: 10 to 9

Saturday: 10 to 6

Sunday: 10 to 5

Sports Cove

1410 E. Monte Vista

Vacaville 95688

(707) 424-5454

Monday-Friday: 10 to 6

Saturday: 10 to 4

Sunday: 10 to 5

Stan's Skindiving

554 S. Bascom St.

San Jose 95126

(408) 294-7717

Monday-Thursday: 10 to 6:30

Friday: 10 to 8

Saturday: 10 to 6

Sunday: 11 to 5

Stan's Skin & Scuba

1900 'A' St., State St.

Ukiah 95428

(707) 462-5396

Monday-Saturday: 9 to 5:30

Closed Sunday

Valley Aquatics

1209 McHenry Ave. #C

Modesto 95350

Diver's Reef

3014 N. Nevada
Colorado Springs 80907
(303) 634-3386
Monday-Saturday: 10 to 6
Leisure Diving
60 S. Havana St. #617
Aurora 80012
(303) 344-0414
Monday-Friday: 10 to 7
Saturday: 10 to 5

CONNECTICUT**Niantic Water Sports**

283 Main St.
Niantic 06357
(203) 739-9598
Summer: Monday-Saturday: 10 to 7
Sunday: 10 to 3
Fall: Tuesday-Friday: 12 to 8
Saturday: 10 to 6

DISTRICT OF COLUMBIA

National Diving Center
4932 Wisconsin Ave. N.W.
Washington D.C. 20016
(202) 365-6123
Monday-Friday: 9 to 7
Saturday: 9 to 5

FLORIDA**ABC Sports, Inc.**

1915 Linton
Ft. Myers 33901
(813) 334-4616
Monday-Friday: 10 to 5:30
Saturday: 10 to 3

Adventure Scuba

150 N. U.S. Hwy. 1
Tequesta 33458
(305) 746-1555
Monday-Friday: 10 to 6
Saturday: 8 to 6
Sunday: 8 to 3

**American Scuba
and Water Sports**

7119 U.S. Hwy. 19
New Port Richey 34852
(813) 848-5085
Daily: 9 to 6

Aquanautes South

903 S.W. 87th Ave.
Miami 33174
(305) 262-9295
Monday-Saturday: 9 to 7

AquaShop

505 Northlake Blvd.
Northlake Beach 33408
(305) 848-9042
Monday-Friday: 9:30 to 6:30
Saturday: 7 to 8
Sunday: 7 to 4

Aquatic Archer, Rd.

Gainesville 32608
(904) 377-DIVE
Monday-Friday: 10 to 7
Saturday: 10 to 5
Closed Sunday

Blue Horizons

3800 Tampa Pkwy. #120
Oldsmar 34677
(813) 854-2298
Monday-Friday: 9 to 8
Saturday: 8 to 8
Sunday: 8 to 2

Buddy's Dive Shop

Mile Marker 85 US 1, P.O. Box 409
Islamorada 33036
1-800-397-4707 In Florida
1-800-233-4707 Others
Daily: 8 to 8

**Captain J's Dive
& Charter Service**

3-1 Hwy. 98
Destin 32541
(904) 654-5300
FAX: (904) 854-5375
Daily: 6 to 8
Dive and Tour, Inc.
1403 E. New York Ave.
Deland 32724
(904) 738-0571
Monday-Saturday: 10 to 6

Divers By The Bay
2550 S.E. Bay Shore Dr.
Coconut Grove 33133
(305) 854-1628
Monday-Saturday: 11 to 10
Diver's Dream

DBA Aquanauts South
903 S.W. 87th Ave.
Miami 33174
(305) 262-9295
Monday-Saturday: 9 to 7

Dive Shop II

Sea Mist Marina
700 Casa Loma Hwy.
Bonita Beach 33435
(904) 655-5660
Monday-Friday: 9 to 7
Saturday & Sunday: 8 to 5
The Diving Locker

223 Sunny Isle Blvd.
North Miami Beach 33160
(305) 947-6025

Monday-Saturday: 9 to 9:30
Sunday: 9 to 6

Good Time Divers and Sports

5724 S.E. Abshier Blvd.
Miami 33162
(904) 245-5711
Daily: 9 to 6

Gulf Coast Pro Dive

7203 Highway 98 West
Pensacola 32506
(904) 456-8845

Monday-Thursday: 9 to 7

Friday & Saturday: 6 to 7

Sunday: 7 to 12

Hall's Dive Shop

1994 Overseas Hwy.
Marathon 33050
(305) 743-5929

Daily: 9 to 6

Key West Pro Dive Shop, Inc.

1605 N. Roosevelt Blvd.
Key West 33040
(305) 296-3823

Ocean Pro Dive Shop Inc.

2259 Bee Ridge Rd.
Sarasota 33579
(813) 924-3483

Monday-Thursday: 10 to 6

Friday: 10 to 9

Saturday: 9 to 6

Panama City Dive Center

4823 Thomas Dr.
Panama City 32408
(904) 235-3390

Daily: 9 to 6

Scuba Shop

348 Miracle Strip Parkway #19
Fort Walton Beach 32548
(904) 243-1600 and 243-3373

Sunday-Friday: 9 to 5

Saturday: 9 to 6

Scuba Services, Inc.

5000 34th St. S. (U.S. 19 S.)
St. Petersburg 33715
(813) 822-DIVE or (800) 74-SCUBA

Daily: 9 to 7

Diver Charters 7 Days a Week

Scuba-Ski Inc.

119 9th St., South
Naples 33940
(813) 262-7389

Treasure Island Divers

111 108th Ave.
Treasure Island 33706
(813) 360-8669

Monday-Saturday: 10 to 6

Vortex Springs

Route 2, Box 18A
Ponce de Leon 32455
(904) 836-4979

Monday-Thursday: 7:30 to 5

Friday-Sunday: 7 to 7

GEORGIA

Atlanta Scuba Center
1925 Piedmont Circle
Atlanta 30324
(404) 872-6448

Monday-Friday: 10 to 7:30

Saturday: 10 to 6

Charbon's Specialty Sports

850 Hwy/Hammock Ave.
Athens 30606
(404) 548-7225

Saturday & Wednesday: 9:30 to 6

Thursday & Friday: 9:30 to 8

Dive, Dive... Dive

Gwinnett Mall Corners Shopping Ctr.
2131 Pleasant Hill Rd.
Duluth 30136
(404) 747-7833

Monday-Saturday: 10 to 7

Closed Sunday

Diving Locker/Ski Chalet

74 W. Montgomery Cross Rd.
Savannah 31406
(912) 927-6603 or 6604

Monday-Friday: 10 to 6

Saturday: 10 to 5

Garratt Dive Educators, Ltd.

2555 Delk Rd.
Marietta 3007

(404) 984-0382

Monday-Saturday: 10 to 9

Golden Isle Dive and Ski

570 Atlantic Ave.
Brunswick 31520
(912) 638-6627

Monday-Friday: 10 to 6

Saturday: 10 to 5

Island Dive Center

1610½ Frederick Rd.
St. Simons Island 31522
(912) 638-8590

Monday-Saturday: 10 to 6

Jungle Ocean Scuba Center

Woolley Plaza Shopping Center
Columbus 31909
(404) 563-8675

Monday-Friday: 10 to 6:30

Saturday: 10 to 5

Seasports, Inc.

11240 Alpharetta Hwy. #200
Roswell 30076

(404) 664-9176

Monday-Wednesday & Friday: 11 to 7

Thursday: 11 to 8

Saturday: 10 to 6

The Dive Shop

2401 B-1 Dawson Rd.
Albany 31707

(912) 436-3033

Monday-Saturday: 8 to 6

Closed Sunday

HAWAII**Central Pacific Divers**

CIO Century Investments
181 LahainaLuna Rd., Suite 1
Lahaina, Maui 96761

(808) 661-4661

Daily: 7 to 9

Fai Wind, Inc.

Kaliua-Kona 96740
(808) 329-6700

Daily: 7:30 to 5

Jack's Diving Locker

PO Box 5306
Kohala-Kona Marketplace

Kaliua-Kona 96745

(808) 329-7585

(800) 345-4807

Daily: 9 to 9

Kohala Divers, Ltd.

PO. Box 4935

Kohala-Kona 96743

(808) 882-7774

Daily: 8 to 5

Kona Coast Skin Diver Ltd.

75-6614 Palani Rd.

Kaliua-Kona 96740

(808) 329-8802

Daily including holidays: 7 to 6

Lahaina Divers

162 Lahaina Rd.

Lahaina, Maui 96761

(808) 661-4505

Daily: 9 to 9:30

Maui Dive Shop

Azalea Plaza Shopping Center

Kihei 96750

(808) 879-3388

Daily: 8 to 9

Ocean Activities Center

3750 Walker Avenue

Maui, Maui 96793

(808) 879-4485

Daily: 9 to 6

Ocean Adventures

406 Kam Hwy

Pearl City, Oahu 96782

(808) 487-9060

Monday-Saturday: 8 to 6

Sunday: 8 to 4

Closed Wednesday

Rainbow Divers

1100 Waikiki Dr.

Waikiki, Oahu 96786

(808) 622-5323

Tuesday-Friday: 9 to 6

Sat. & Sun.: 8 to 6

IDAHo**Dive Magic**

236 Main Ave. N.

Twin Falls 83301

(208) 733-1979

Monday-Friday: 9 to 5

The Scuba Diving Co.

3707 Overland Road

Boise 83705

(208) 343-4470

Daily: 9:30 to 6:30

ILLINOIS**Adventures In Scuba, Inc.**

1730 W. Fullerton

Chicago 60614

(312) 935-DIVE (3483)

Monday-Friday: 11 to 9

Saturday: 9 to 5

Forest City Scuba**& Sport Center, Inc.**

1894 Dainger Rd.

Rockford 61112

(712) 598-7110

Monday-Thursday: 10 to 8

Friday: 9 to 9

Saturday: 8 to 5

Scuba Diving Schools of America, Inc.

4 S. 100 Route 59, Unit 19

Naperville 60563

(708) 393-7060

Monday-Friday: 10 to 8

Tuesday & Thursday: 10 to 9

Saturday: 10 to 4

IOWA**Iowa State Skin Diving**

Schools, Inc.

100 University Plaza

7500 W. University Ave., Suite C

Des Moines 50311

(515) 255-8999

Monday-Friday: 10 to 7

Saturday: 10 to 6

INDIANA**Divers Supply Company, Inc.**

3301 N. Illinois St.

Indianapolis 46208

(317) 923-5335

Mon., Wed. & Fri.: 9 to 7:30

Tues. & Thurs.: 9 to 5:30

Saturday: 9 to 5

Divers World

1271 E. Morgan Ave.

Evansville 47711

(212) 423-2736

Monday-Friday: 10 to 6

Saturday: 8 to 5

DNP Diving, Inc.

604 E. Main

Logansport 46947

(219) 735-3483

Monday-Friday: 8 to 4

Pro Dive Shop
3203 Covington Rd.
Ft. Wayne 46804
(219) 432-7745
Mon., Tues., Thurs. & Fri.: 12 to 6
Saturday: 9 to 1

KANSAS

The Dive Shop
7300 W. Frontage Rd.
Merriam 66204
(913) 677-3483
Daily: 10 to 7

KENTUCKY

Laurie Diving Headquarters
414 Master St.
Corbin 40701
(606) 523-1360
Hours: 9 to 6

Lexington Dive

2680 Wilhite Drive
Lexington 40508
(606) 277-5799
Monday-Friday: 10 to 7
Saturday: 10 to 5

Louisville Dive Shop

2478 Bardstown Rd.
Louisville 40205
(502) 458-8427
Monday-Friday: 11 to 7
Saturday: 11 to 5
Undersea Adventures
 Hwy. 80
 Hurricane 41749
(606) 279-3172
Monday-Saturday: 9 to 6

LOUISIANA

Divers Destination of Louisiana
201 N. Main Street
Lafayette 70503
(318) 984-4678
Monday-Saturday: 10 to 6

Houma Watersports

3219 W. Main
Houma 70360
(504) 879-2900
Monday-Friday: 10 to 6
Saturday: 10 to 3
Sea Horse Diving Academy
8726 Che Menteur Highway
New Orleans 70127
(504) 246-6529
Monday-Friday: 11 to 7
Saturday: 10 to 6
Seven Seas
7865 Jefferson Highway
Baton Rouge 70809
(504) 926-1819
Monday-Saturday: 9:30 to 5:30

The Water Habitat, Inc.

1602 Jackson St.
Alexandria 71301-0442
(318) 443-5100
Mon., Wed., & Fri.: 10 to 6
Saturday: 10 to 5

MAINE

Aqua Diving Academy
1183 Concourse St.
Portland 04102
(207) 772-4200
Monday-Friday: 10 to 6
Saturday: 10 to 5
Skin Diver's Paradise
784 Turner Rd.
Auburn 04210
In Maine: (800) 427-DIVE
(207) 782-7739
Monday-Friday: 10 to 8
Saturday: 8 to 6

MARYLAND

Bethany Water Sports
3275 Bethany Ln.
Elliot City 21043
(301) 461-DIVE
Monday-Friday: 12 to 7
Saturday: 11 to 5

Divers Den Inc.
8105 Harford Rd.
Baltimore 21234
(301) 668-6666
Mon., Tues., Thurs., & Fri.: 9:30 to 9
Wed. & Sat.: 9:30 to 5
The Scuba Hut, Inc.
139 Delaware Ave.
Gloucester Point 21061
(301) 761-4520
Mon., Wed., & Fri.: 10 to 8
Tuesday & Saturday: 10 to 6
Tidewater Aquatics
1315 Forest Dr.
Annapolis
(301) 268-1992 or (800) 637-2090
Monday-Friday: 12 to 7
Saturday: 10 to 5

MASSACHUSETTS
Aquarius Diving Center Inc.
3239 Cranberry Hwy.
Buzzards Bay 02532
(508) 759-DIVE
Monday-Friday: 10 to 7
Saturday: 8 to 4
International Divers Supply
49B Winn St.
Burlington 01803
(617) 272-5164
Summer: Monday-Friday: 10 to 8
Saturday: 9 to 5
Sunday: 8 to 4
Winter: Monday-Friday: 10 to 6
Saturday: 9 to 5
Closed Wednesday & Sunday
Merrimack Aquatic Center
171 Merrimack St. Route 110
Methuen 01844
(508) 688-6566
Monday-Friday: 11 to 7
Saturday: 12 to 4
Pro Dive USA, Inc.
236 Woods Rd.
Braintree 02184
Open seven days
Ultramarine Divers
101 Commonwealth Ave.
Concord 01742
(508) 369-1154
Daily: 10 to 8
Whaling City Diving Center
100 Whaling City Road, Rt. 6
New Bedford 02740
(617) 992-2662
Monday-Friday: 10 to 8
Saturday: 9 to 6
Summer/Sunday: 9 to 4

MICHIGAN

Divers Incorporated
3380 Washington Ave.
Ann Arbor 48104
(313) 971-7771
Monday-Friday: 10 to 8
Saturday: 10 to 5
Closed Tuesday & Sunday
The Dive Shop
G 4020 Corunna Rd.
Pittsfield 04669
(313) 732-3900
Monday-Saturday: 9 to 6
Late Appointments Available
The Dive Site
9125 Portage Rd., Suite A
Kalamazoo 49002
(616) 323-3700
Monday-Friday: 10 to 7
Saturday: 1 to 5
Recreational Diving Systems
4424 N. Woodward
Royal Oak 48072
(313) 549-0303
Monday-Friday: 10 to 7
Saturday: 10 to 5

Scuba North, Inc.
13380 W. Bayshore Dr.
Traverse City 49684
(616) 947-2520
Monday-Thursday: 9 to 6
Friday-Saturday: 9 to 7
Sunday: 9 to 5
(Winter) Mon.-Sat.: 10 to 6
The Scuba Shack
9982 W. Higgins Lake Dr.
Higgins Lake 48627
(517) 821-6477
(Summer) Monday-Friday: 9 to 5
Saturday & Sunday: 8 to 8
Seaqueatics, Inc.
979 S. Saginaw Rd.
Midland 48640
(517) 835-6391
Monday-Friday: 10 to 6
Saturday: 10 to 5
Skamt Shop
5055 Plainfield N.E.
Grand Rapids 49505
(616) 364-8418
Monday, Wednesday, Friday: 10 to 6
Tuesday, Thursday, Saturday: 10 to 6
Tom & Jerry's Skin
& Scuba Shop
20318 Van Buren Ave.
Dearborn Heights 49125
(313) 271-1111
Monday-Friday: 11 to 7
Saturday: 11 to 5
ZZ Under Water World, Inc.
1806 E. Michigan Ave.
Lansing 48912
(517) 485-3894
Monday-Friday: 10 to 7
Saturday: 10 to 5
MINNESOTA
Club Scuba East
3035 White Bear Ave.
Maplewood 55109
(612) 770-5555
Monday-Friday: 10 to 8
Saturday: 10 to 5
(Summer) Sunday: 9 to 1
Club Scuba West
300 E. Washington Blvd.
Wayzata 55391
(612) 473-4266
Monday-Friday: 10 to 8
Saturday: 10 to 5
(Summer) Sunday: 9 to 1
Fantasea Scuba
Located just 10 minutes
from the Minneapolis
International Airport
(612) 890-DIVE (612-890-3483)
Monday-Friday: 10 to 8
Saturday & Sunday: 10 to 6

MISSISSIPPI

Out and Under

1200 Robbie Dr.
Meridian 39301
(601) 693-5267
Monday-Saturday: 10 to 6
MISSOURI
Academy of Scuba Training, Inc.
437 N. Main
Cape Girardeau 63701
(314) 335-0756
Monday-Friday: 9 to 6
Saturday: 9 to 5
Aquasports, Inc.
5601-A S. Campbell
Springfield 65807
(417) 883-5151
Monday-Friday: 9 to 7
Saturday: 9 to 5
Closed Sunday
Captain Nemo's Dive Shop
1414 W. Rangebine
Columbia 65201
(314) 442-3483
Monday-Friday: 10 to 6
Saturday: 10 to 5

MISSISSIPPI

Underwater Sports Inc.
Route 17 South
Rochelle Park 07662
(201) 843-3340
Monday: 10 to 7
Tues.-Fri.: 10 to 9
Sat.: 10 to 6

Divers Village
PO Box 329, Lake Rd. West 20
Lake Ozark 65049
(314) 365-1222
Daily: 9 to 5
Table Rock State Park Marina
S.R. 1, Box 911
Branson 65616
(417) 334-5699
Daily, sunrise to sunset
Nov. through Feb., open by app't.

The Dive Shop North

2526 N.E. Vixon
Kansas City 64118
(816) 455-1942
Monday-Friday: 10 to 7
Saturday: 10 to 5

NEBRASKA

Big Mac Scuba & Sail
4711 Huntington St., Suite #1
Lincoln 68503
(402) 466-8404
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Reno 89502
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Saturday: 10 to 5

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Alofi, Niue Island

Phone: 102

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Scubahire Ltd.

Many unusual creatures are found in a harbor, but photographing them requires patience and skill.

BY JOE BELANGER

Imagine taking underwater photographs in waters where the visibility is no more than five feet and depth averages 10 feet, not counting the one foot of mud your knees have sunk into. After exiting the water you may notice tiny, ant-like amphipods crawling on your wet suit. But after all is said and done, you actually had fun, and may have shot some terrific unusual pictures. Such an environment exists for any diver to explore, which is both a placid setting and easily accessible. For a real change of pace, try your hand at underwater photography in a harbor.

Harbors provide the opportunity to photograph unusual aquatic life forms, rather than the everyday creatures most underwater photographers shoot. For instance, every California underwater photographer has at one time or another photographed the Spanish shawl nudibranch, and for good reason! The Spanish shawl is one of the most beautiful nudibranchs. The problem is everyone seems to have pictures of these guys. If you want a picture of something really distinctive, you must dive somewhere off the beaten path—a harbor, for instance.

Harbor animals, or more specifically, calm-water animals, have adapted to a way of life very different from that of their open-water counterparts. Calm-water creatures must be able to tolerate fluctuations in salinity resulting from the harbor's rate of evaporation and influx of rainfall or freshwater runoff. A more obvious adaptation is evidenced by the fact that a great many harbor animals are sessile, meaning they attach themselves to some sort of substrate, such as boat docks. Some are also very fragile and cannot handle the rigors of the open ocean. Since harbors provide calm waters, they make ideal homes for these kinds of animals. Additionally, flat fish such as juvenile halibut find protection in harbors until large and strong enough to handle the environment of the open ocean.

I first noticed the uniqueness of harbor animals several years ago, while participating in a diving project in Huntington Harbor, California. During my dives, unusually shaped animals kept catching my eye, distracting me from the job. The striped tunicate, *Styela plicata*, and California bubble snail, *Bulla gouldiana*, were the first creatures to arouse my curiosity. But as the days passed, animals such as the feather duster worm became equally interesting. Because the animals looked so different from any I'd encountered before, I wanted to catch

Joe Belanger is a California-based diving instructor and photographer. This is his first contribution to SCUBAPRO Diving & Snorkeling.

their images on film. So as to better understand these creatures before photographing them, I studied them in the Audubon Society Field Guide, and conferred with a marine biologist.

Apparently, filter feeders such as the striped tunicate have adapted to harbor environments for two major reasons. First, boat docks provide an ideal substrate for attachment. Since the water is calm, harbors provide an extra incentive for these attaching animals to move in. But the main reason filter feeders live in such surroundings is for the turbid water harbors provide. Harbors act as sediment traps, accumulating a wealth of fine, suspended particles. These particles are the "Big Macs" of the filter feeders' food chain.

On the other hand, the bubble snail prefers harbor environments for their calm, muddy bottoms. Bubble snails' shells are very fragile and require placid surroundings. The snails bury

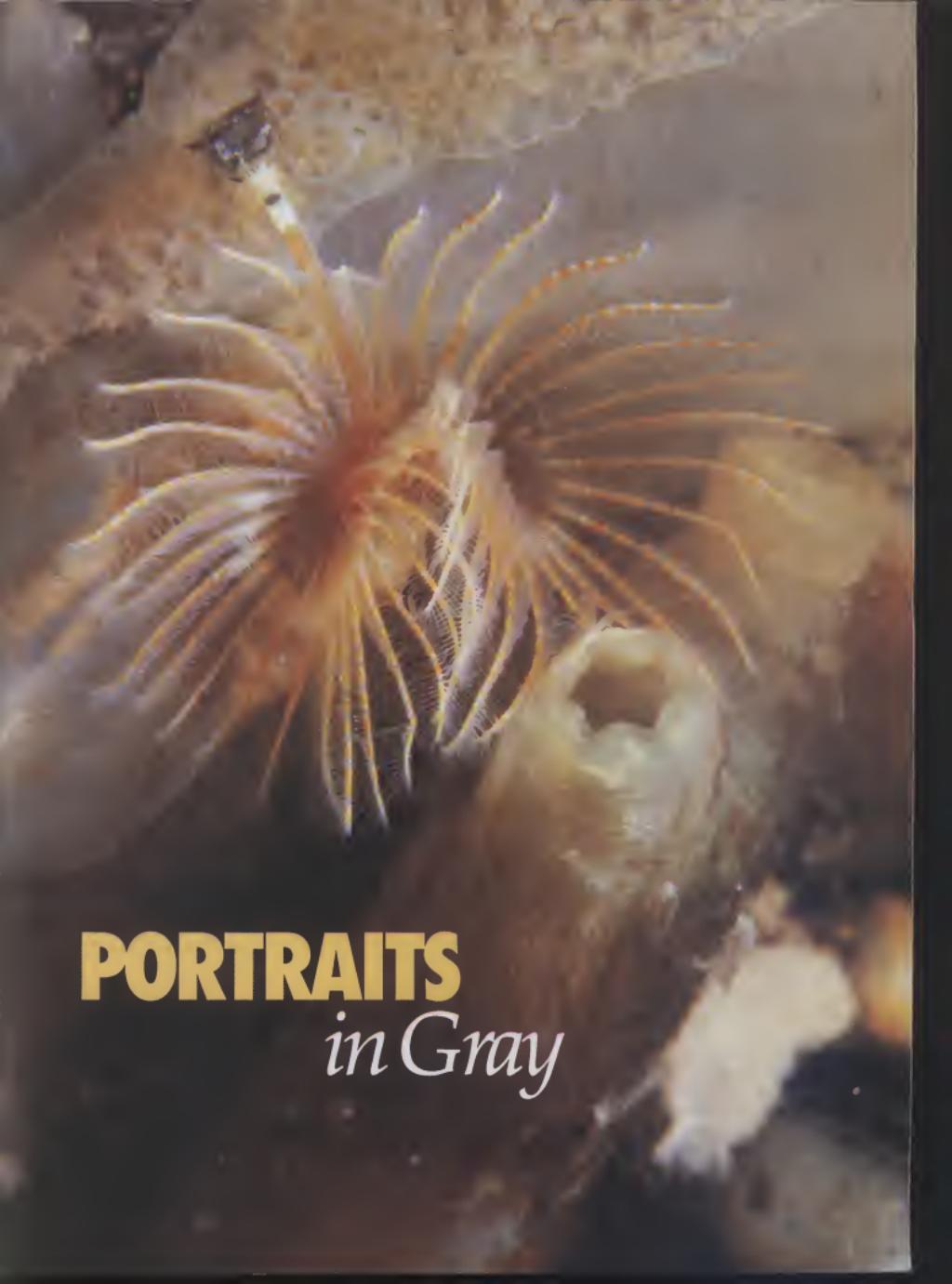


Bubble snail and tube worm, opposite.

themselves in the muddy bottoms during the day, becoming active feeders at night. But the bubble snail's primary reason for living in such an environment is the same as that of the filter feeders: food. Bubble snails feed on the green, matted algae that forms over mud bottoms near eelgrass beds and other harbor vegetation. Photographing these guys can be a real challenge.

The main attribute a photographer must possess if he wants to photograph harbor animals is patience. If your patience level is not a perfect 10, then forget it. Remember, these are calm-water animals, used to quiet environments. Any disturbance may cause them to close up, swim away, or take a dive below the sediment.

For this reason, I recommend using a housed system rather than a framer system. Harbor animals do not like framers! But if a framer system is all you have, don't give up. Most of the photographs in this article were shot with a Nikons extension tube system—it just took a great deal of patience. I did discover that Lady Luck was with me more often when I left the framer

A close-up photograph of a lionfish's mouth and tentacles. The lionfish has a light-colored body with prominent red and white radial tentacles around its mouth. Its mouth is slightly open, revealing its internal structures. The background is dark and out of focus.

PORTRAITS

in Gray

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around the subject while advancing film. The animal tends to become more disturbed when you keep coming back over it with the frame between shots.

After tackling the disturbance dilemma, divers must deal with the problem of visibility. This is not usually a problem on the docks, but it can be a big one when you're taking pictures on the bottom. Remember the last time you drove your car in thick fog? Well, you get the same feeling by swimming into the giant plume you just accidentally kicked up. The sensation is eerie and disorienting, but what's worse is that the subject disappears, and finding a new one is not always easy.

The fine sediment characteristic of harbor bottoms is probably the photographer's worst enemy. It is better to begin a harbor dive at the site's deepest point, then to slowly move up to shallower, livelier areas. This is because plumes tend not to travel up a sloping bottom. At the very least, they stay behind the photographer, allowing maximum visibility.

Once your first rolls of film come back from the processor, you will begin to see how bad pictures can be made better (positioning, lighting, etc.). One problem is the harbor animals' inherently drab colors, which pose a real concern since we all like colorful pictures. Fortunately, there is the technique of placing a diver in the picture to enhance contrast. Remember, interacting with animals can make a photograph much more meaningful, and in some cases more valuable.

When shooting wide-angle pictures in harbors, however, it is important to keep the distance between camera and subject to a minimum. The turbid waters can easily cause backscatter, ruining a photograph. To help avoid this calamity, it's important to position your strobe at a 45-degree angle to the subject. For instance, when shooting horizontal

photographs, place your strobe above your head, on the horizontal plane of your camera, and point it down, toward the subject. The same technique should be used when shooting vertical photographs, except that the strobe is held out to your left side instead of over your head. This technique helps to reflect strobe light off the sides of suspended particles, reducing backscatter.

If using a diver as a subject is not possible, keep in mind that harbors play host to a couple of colorful, carnivorous nudibranchs. *Navanax*, *Chelidonura inermis*, and the thick-horned aeolid, *Hermisenda crassicornis*, inhabit such environments primarily because of the available food supply. The bubble snail is their main food source, but other ophistobranchs, including their own species, will satisfy their appetites just fine. The navanax habitat generally consists of calm, shallow, muddy bottoms. But *Hermisenda* have adapted to the rigors of both open ocean and calm-water environments, making them quite the feared predator. Nevertheless, they are strikingly hued animals, ideal subjects for adding color to your harbor photography portfolio.

There is a "Far Side" cartoon that reminds me of harbor diving. It depicts a boy curled beneath his blankets while breathing through a snorkel to obtain fresh air. He is hiding from imaginary monsters. Sometimes I think Gary Larson ("Far Side" creator) got this idea from making a harbor dive. The bottom line is that harbor diving may not be for everyone. But if the will to be different and the desire to catch the unusual on film is in your blood, then give harbor diving a try.

Editor's Note: Because of boat traffic, diving is often restricted to certain times of the day in some harbors. Be sure to check with authorities before diving in any harbor. \$

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WASHINGTON

(Continued from page 44)

Also readily available are the natural wonders of nearby Olympia National Park. Less than an hour away by car, Hurricane Ridge rewards the diver with its unparalleled views of the majestic Olympia Mountains, Vancouver Island and the Strait of Juan de Fuca. Within the vast park boundary are several hot springs, as well as the only temperate rain forest in the United States. Back near camp, a spectacular shipwreck lies offshore, a quarter-mile from Salt Creek. The freighter *Diamond Knot* sank here in 130 feet of water, after colliding with another ship in the fog on August 13, 1947. Over the years, the broken remains of its 326-foot hull have become a colorful shrine of encrusting marine life. Extreme offshore currents and limited visibility make this an experience for advanced divers only.

The San Juan Islands

The 360-degree view from the top of 1,000-foot Mount Constitution justifies the trip to the San Juans. This Orcas Island summit provides a bird's-eye view of many of the islands that make up the San Juan archipelago. The four largest islands, San Juan, Orcas, Lopez and Shaw, are serviced year-round by Washington ferries. The mainland

departure point is Anacortes, some 60 miles south of the U.S./Canada border. The lovely two-hour ride includes stops at all four islands, ending at Friday Harbor on San Juan. Friday Harbor, the largest city on the islands, offers wonderfully quaint shops and restaurants, and is the site of the renowned Whale Museum.

The constricted, fjord-like channels throughout the many islands are swept by strong currents, up to six knots. The steep walls and fast currents add up to exciting diving all over the archipelago. Shore dives are limited by the lack of beach access, as the shoreline consists mainly of steep cliffs, though Deadman Bay, San Juan County Park and Eagle Cove on San Juan all offer fine shore dives.

The prolific marine life in these waters prompted the University of Washington to establish a marine biology research lab at Friday Harbor in 1904. Killer whales frequent the west side of the island and can often be observed near shore at the Lime Kiln Lighthouse. The waters hold a variety of sea stars and nudibranchs dressed in shocking colors that seem to glow under the glare of a dive light. Shy harbor seals inhabit the many sun-draped kelp forests.

Naturalists, sailboaters and pleasure cruisers enjoy these often sun-drenched islands on a year-round basis. Snug

Harbor offers diving packages, complete with accommodations and dive boat. West Beach Resort on Orcas Island is heavily booked by divers. Boats and fishing gear are available for rent. Because the area is so popular with divers, several charter boats such as the *Starfire* and *Sea Wolf* book trips throughout the year to innumerable dive sites reachable only by boat.

Puget Sound

What diver would ever imagine that on the outskirts of Seattle, a city park could offer shore access, showers, shipwrecks, sea lions and a smorgasbord of sea life? Right beside the Edmonds Ferry Terminal, a city park encompasses one of the busiest dive sites in the country. Every year, thousands of divers slip below the water to explore the remains of an old dry dock and two wooden tugs, the *Altak* and the *Fossil*. The old dry dock was originally sunk to act as a current shield for the adjacent ferry terminal. The tugs were added after the area was designated an underwater park and marine preserve in 1970. The sunken vessels have created a flourishing artificial reef. Large lingcod, cabezon and rockfish are plentiful, though California sea lions have thinned their numbers somewhat. The park's small parking lot is jammed on weekends, as diving instructors often

DIVER'S SUPPORT

(Continued from page 44)

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Washington State Parks & Recreation
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Washington State Fisheries
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Rules & Regulations

All underwater parks in the Puget Sound area are marine reserves. No taking of marine life is allowed.

Divers must possess a Washington State fishing license to spear fish.

It is unlawful to take or possess salmon, octopus or crabs with a spear.

Divers must wear a buoyancy compensator and dive with a buddy in all underwater parks.

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Further Reading

Northwest Shore Dives by Steve Fischbacher (*Bio-Marine Images*, 1990).

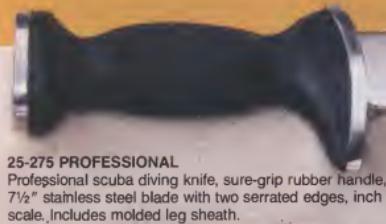
141 Dives in the Protected Waters of Washington and B.C. by Betty Pratt Johnson (*Gordon Soules Book Publishers*, 1977).

Seashore Life of the Northern Pacific Coast by Eugene Kozloff (*University of Washington Press*, 1983).

The San Juan Islands Afoot and Afloat by Marge Mueller (*Mountaineers*, 1979).

The Mountaineers published a large list of boating, camping and nature guidebooks of locations all over the Pacific Northwest.

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South along the waterfront a few blocks past the Edmonds Marina is Edmonds Marina Beach Park. This dive entails a long swim under the Edmonds Oil Dock. Fields of frilly orange sea pens brighten the swim to the end of the pier. On a clear day, the effect of sun streaming through vertical stacks of colorfestooned pilings is quite dazzling. Giant purple and red tube worms, multi-colored sea anemones and several types of nudibranch, completely cover every submerged surface. Another marine preserve halfway between Seattle and Tacoma is Saltwater State Park. A long, 300-yard swim is rewarded by a large sunken barge in 50 feet of water. The marine preserves are perfect places for underwater photographs. Fish of all species ignore divers and have to be practically pushed out of your way.

Farther south, an 80-mile extension of Puget Sound separates the Kitsap and Olympia peninsulas. Known as Hood Canal, there are numerable shore accessible dive sites such as Twanoh and Potlatch State Park, Sunde Rock and Octopus Hole. Amazingly, the visibility is often much better at Hood Canal than in the rest of Puget Sound. This is particularly true in the spring and summer. Some huge octopus are regularly sighted at Titlow Beach near Tacoma and throughout the Hood Canal.

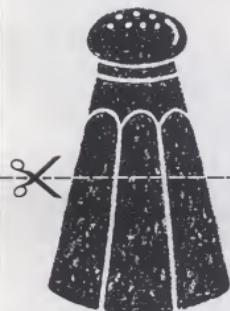
Many of the scenes for the movie *An Officer and a Gentleman* were filmed at two northern Puget Sound parks: Fort Warden State Park (north of the historic city of Port Townsend) and Fort Casey (directly across from Admiralty Inlet on Whidbey Island). Fort Casey was built to guard the entrance of Puget Sound during the Spanish American War; it houses old bunkers and gun emplacements. Both Fort Warden and Fort Casey were further fortified for a possible sneak attack by the Japanese in World War II. Both parks are great for picnics and pictures.

Keystone Jetty is adjacent to Fort Casey and is probably the second most popular dive in Washington. This man-made jetty extends 75 yards off a sandy beach to a maximum depth of 60 feet. The huge boulders that form the jetty provide numerous hiding places for hundreds of marine animals. Giant barnacles, octopi, sea anemones, kelp greenling, schools of rockfish and herring are common to this wildlife reserve. Near Fort Warden is an old pier where many old artifacts and antique bottles have been uncovered.

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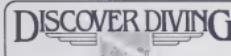
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CABRILLO

(Continued from page 10)

headlands and shifting sand dunes. The island has a low profile compared to its southern neighbors, as it takes the brunt of northern weather deflected off the central California coast.

But when calm conditions prevail, San Miguel boasts what many consider to be the best diving in the Channel Islands. Visibility averages 30 to 40 feet. However the extreme north end of the island is often fed clean, clear oceanic currents with surprising clarity. The waters near Point Bennett and Richardson's Rock often take on a brilliant shade of cobalt blue. When conditions are good at San Miguel and the weather allows dive boats to range freely throughout the area, every diver aboard knows they've landed into something very special.

San Miguel is best known for its spectacular pinnacle dives at Wilson's Rock, Richardson's Rock, Skyscraper, and Boomerang Bank. Several of these sea-mounts break the surface, while others end far below. On the deeper sea-mounts divers find a dream world of dazzling red, white, blue and violet club-tipped anemones, large orange and

grey mantled scallops, a plethora of branching gorgonian fans and numerous mottled and camouflaged rockfish hiding among the crevices. These underwater peaks vary from rambling, steep-sided structures to sheer underwater precipices plummeting to depths of hundreds of feet. Divers can encounter exotic monkey-faced eels, incredible varieties of multicolored nudibranchs, large lingcod, angel sharks, large torpedo rays and sea lions and elephant seals.

Closer to shore in the sandy flats of Cuyler Harbor, divers find large specimens of California halibut. Red abalone are often found in the kelp beds, making them popular with commercial abalone divers.

San Miguel is protected by both distance and weather. It is a hidden jewel often blanketed with clouds and inaccessible because of high winds and heavy seas. When favorable weather allows boats into the area, San Miguel is a diver's paradise.

The Santa Barbara Channel Islands fulfill many roles. To fishermen they are a vital resource. To the archaeologists they represent a field laboratory to study cultures long extinct. Historians study the island's legacy and divers continue to explore new frontiers underwater.

The islands were one of the first encounters made by Cabrillo during his voyage of discovery for Spain. They were also his undoing. Injured in a fall on San Miguel, Cabrillo's broken arm and shoulder tissue quickly infected and turned gangrenous. Aware his time was short, Cabrillo weighed anchor and continued exploring the cold, violent coast as far north as Cape Mendocino. Too weak to continue himself, and with a crew desperately ill from scurvy, Cabrillo ordered the caravels to retreat to Cuyler Harbor at San Miguel Island. A short time after returning to La Possession, he died. His crewmen renamed the island La Capitana in his honor. It was a short, but fitting eulogy until the permanence of Vancouver's charts showed a new name.

Today, when dive boats weigh anchor in the late afternoon to return to the mainland, the wind continues to whistle out of the north as it has since the beginning of time. Sheets of spray crack like a whip across the bow, lashing crew members securing the anchor. California brown pelicans soar majestically along the humps of rolling swells, scanning the deep blue water for an evening's meal. Gullsicker noisily in flight while sea lions bark among the rocks. Divers break out jackets to ward off the spray and chill, and prepare for the long, rolling ride home. It's easy to envision a small fleet of leaking caravels fighting their way into the north wind. \$

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TABLES

(Continued from page 52)

stops than required by Haldane theory. These are entirely consistent with minimizing bubble growth and the excitation of nuclei through the application of increased pressure.

As expected, any dive regimen so radical does result in a number of cases of bends. Consequently, the Australians have developed simple, but effective in-water decompression procedures. The stricken diver is taken back down to 30 feet where he breathes oxygen for about 30 minutes in mild cases, or 60 minutes in severe cases. Increased pressures help to shrink bubbles, while pure oxygen encourages dissolved gas elimination. These recompression time scales are far too short for Haldanean decompression, but are consistent with bubble research.

Hawaiian net fishermen utilize similar procedures, making eight to 12 dives a day to depths which may exceed 350 feet. Although they, too, know nothing of bubble models or of nucleation theory, their protocols are consistent with them. The deepest dive is made first, followed by shallower excursions. A typical series might start with a dive to 220 feet, followed by two dives to 120 feet, and finish with three or four dives to less than 60 feet. Little or no surface intervals are clocked between dives.

These procedures virtually rape the Haldanean tables, but make sense when viewed in the light of bubble mechanics. Ascending profiles (deepest dive first, followed by shallower ones) and deeper decompression stops keep micronuclei excitation and bubble growth within the body's capacity to eliminate both inert gas phases. The final shallow dives can be viewed as prolonged safety stops. In-water recompression procedures are similar to those of the Australians.

Obviously, no sport diver should attempt these profiles. The risk of bends, while less than expected, is still far too high to be acceptable. Additionally, the extreme depths mentioned would result in oxygen toxicity for most divers.

Many scientists scoff at these seat-of-the-pants decompression methods. But the Hawaiian procedures have been duplicated experimentally in animals by Tom Kunkle and Ed Beckman.

At Catalina Island, Andy Pilmanis took people on bungee dives to 100 feet. Some came up directly, others made safety stops in the 10- to 20-foot range. Venous bubbles occurred four to five times less in the group making the safety stops. From this and other related research has come the current American Academy of Underwater Sciences (AAUS) recommendation of a five-minute safety stop between 15 and 25

feet after any dive near the limits of the tables.

Wienke is presently working on a new diving algorithm based on bubble mechanics theory. It will track both free-phase (bubble theory) and dissolved-phase (Haldanean theory) dynamics. He is encouraged so far, reporting that when certain parameters are tweaked, things go the right way. That's not always the case with Haldane's model. Testing and implementation are still required, but when it's finished, Wienke's algorithm could change the way we dive, just as the first dive computers did.

I asked Bruce to discuss some features of the new algorithm, and how it will differ from present models. Here are some of them:

Safety stops will be an essential component, because if you catch the bubbles while they are small enough, they are easier to stabilize. These stops would be at around 15 to 25 feet, about the same as AAUS recommendations. The higher ambient pressure (than the usual ten-foot stop) compresses bubbles, allowing them to pass through the pulmonary filter system, break up, or dissolve. The smaller the bubble, the easier it is eliminated. Dissolved gas buildup in slow tissues during a safety stop is negligible, compared to the benefit of the reduction in bubble growth.

Deep repetitive dives with short surface intervals will be restricted. Deeper exposure on subsequent dives would carry a far greater time penalty than present models. The reason is that these dives excite additional, smaller classes of micronuclei after larger classes have already been excited on the previous dive. The result is a greater risk of bends.

Because the body's ability to eliminate free-gas phases decreases with time at pressure, no-decompression limits will be shorter than the Navy Tables. Surface intervals will be longer than present computer algorithms. The 60-foot-per-minute ascent rate will probably be retained, because most divers haven't mastered it, much less the slower rates dictated by most computers in use. Safety stops effectively take care of slowing down ascent rates, and they are more efficient.

But the primary difference from a scientist's standpoint is that decompression procedures will flow naturally from this model; it will be a more realistic and more accurate predictor, without the jury-rigging and quick fixes required to keep the Haldanean model going.

Until the new model is ready, we are stuck with our present tables and computers. In the interim, Wienke recommends some procedures we can follow right now to make our diving safer.

These have come out of recent workshops and technical forums.

1. Make no more than three repetitive, deep dives per day.
2. Avoid multi-day, multilevel, or repetitive dives to increasing depths. Make the deepest dive first.
3. Wait 12 hours before flying after regular diving, 24 hours after heavy diving (hard work, near decompression limits, or prolonged repetitive activity).
4. Avoid multiple ascents to the surface and short repetitive dives (spike diving) within surface intervals of one hour.
5. Surface intervals of over an hour are recommended for repetitive diving.
6. Safety stops for two to four minutes in the 15- to 25-foot zone are advisable for all diving, but especially for deep, repetitive, multi-day exposures.
7. Do not dive at altitudes above 10,000 feet using conventional dive tables with altitude modifications.
8. Dive conservatively. Tables and meters are not bends-proof.

S

Trivia Quiz

ANSWERS

1. Artificial reefs
2. The moon. Because it is so much closer to the earth.
3. Flood Tide. The opposite is Ebb Tide.
4. c.
5. Tide Tables
6. Positive Color Film
7. False
8. Rays. If you said fish, give yourself 2½ points.
9. False
10. 1 = b; 2 = d; 3 = e; 4 = a; 5 = c
11. Puerto Rico
12. Zale Perry
13. F. Romano
14. Commodore Sullivan
15. 1 = c; 2 = e; 3 = a; 4 = b; 5 = d
16. (a) 5 (The actual number was 1,956 vessels.) (b) 7.8 million tons of shipping was lost in five years.
17. At least one month
18. Advanced diving course, or open water course
19. 1 = d; 2 = c; 3 = a; 4 = b
20. The "100-foot hole" of Waikiki is a giant piece of Diamond Head Crater that was blasted into the ocean ages ago. It has tunnels and caves filled with marine life. It is 80 feet to the top of this chunk of volcanism.
(b) Three kinds of lobster.

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